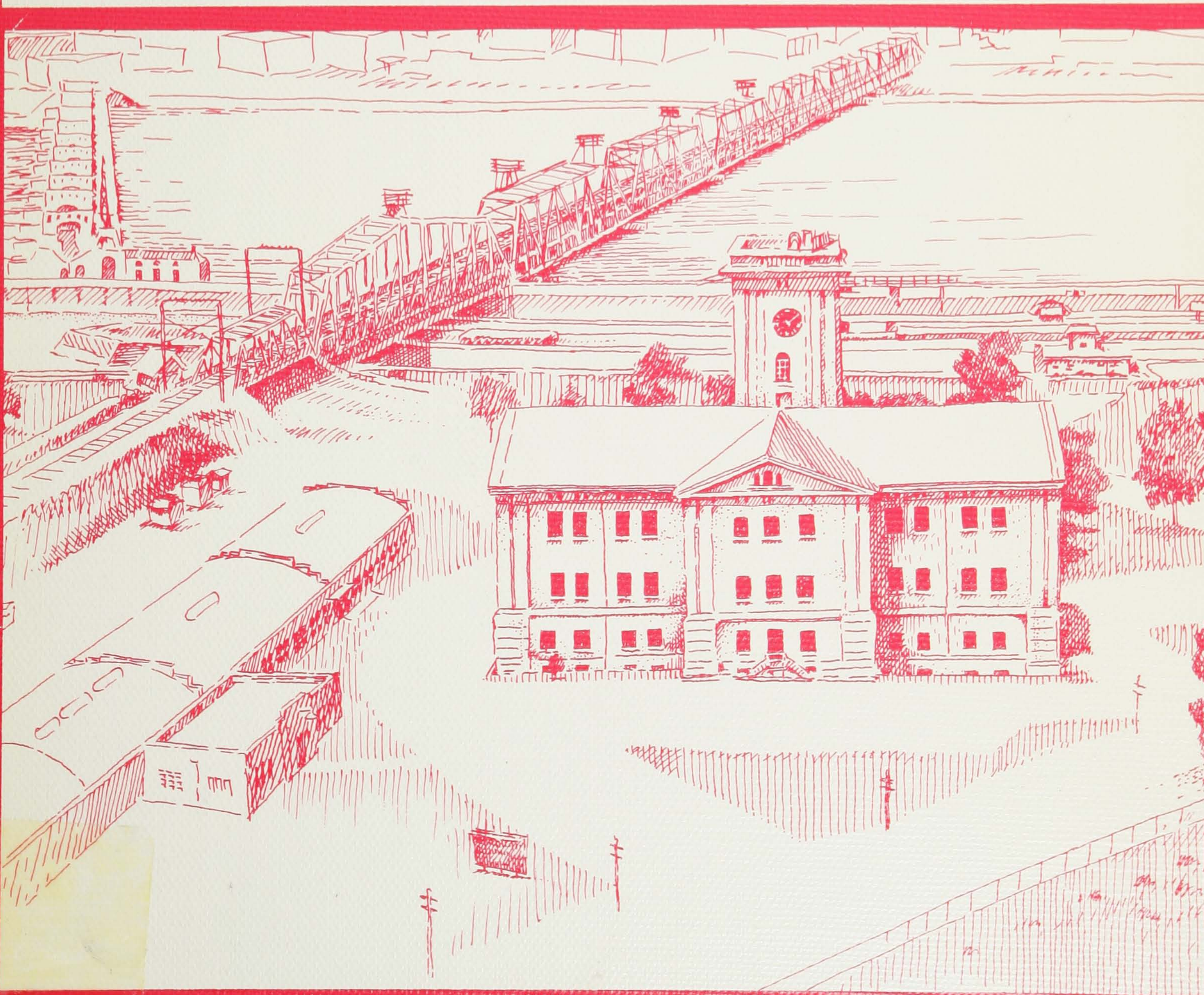
# A HISTORY OF THE ROCK ISLAND DISTRICT

# CORPS OF ENGINEERS

## 1866-1975



# Report Documentation Page

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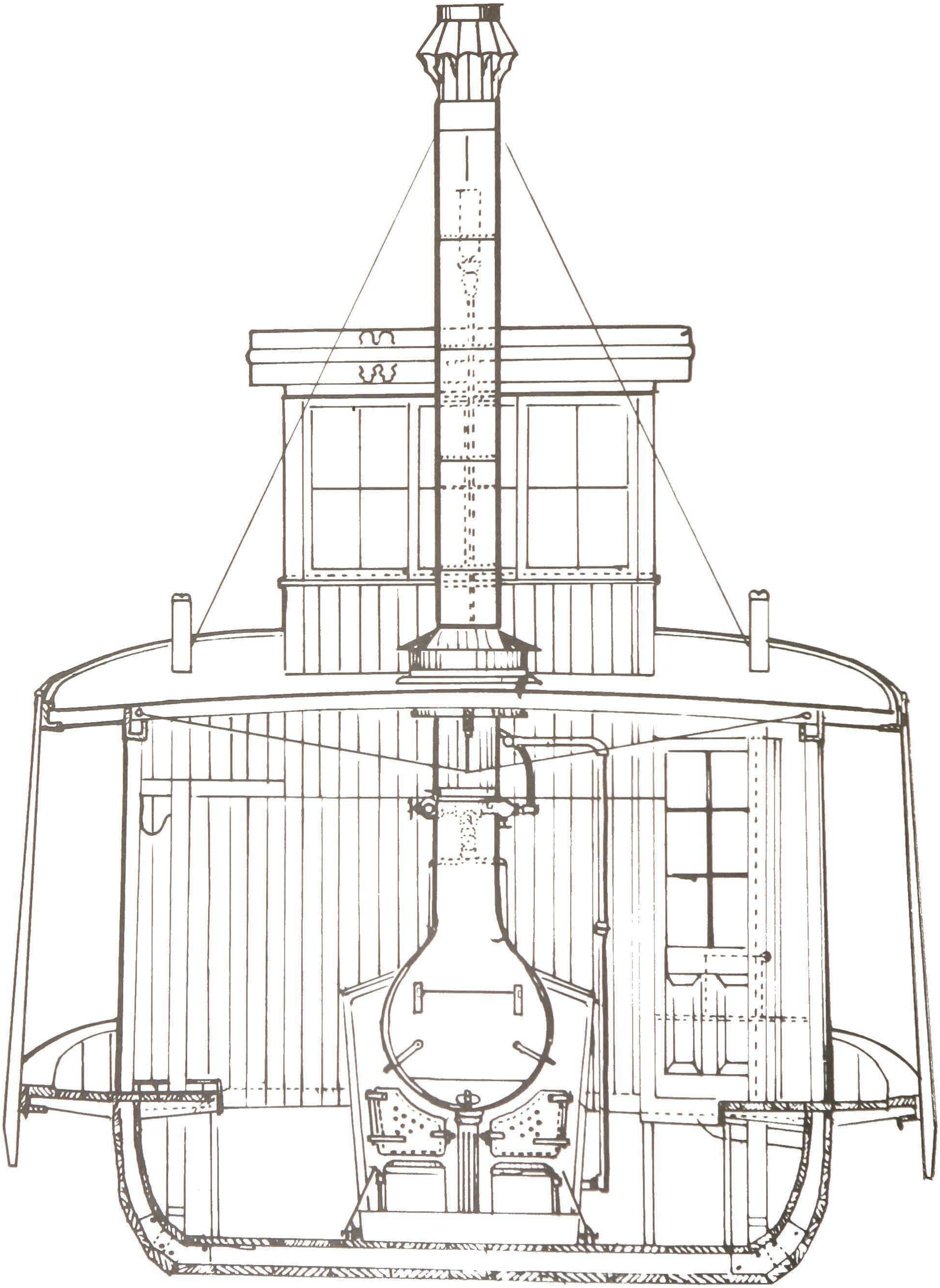

# A HISTORY OF
# THE ROCK ISLAND DISTRICT
# CORPS OF ENGINEERS

By

Roald Tweet

U. S. ARMY ENGINEER DISTRICT, ROCK ISLAND

ROCK ISLAND, ILLINOIS

JUNE 1975

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# CONTENTS



COVER. Designed and drawn by Loren Carey. The drawing shows the Clock Tower Building, home of the Rock Island District; Lock and Dam 15, the first project on the 9-foot channel; and the Government Bridge, designed and built by the Corps of Engineers in 1872.

FRONTISPIECE. Crossection of the U. S. Steam Launch *Lucia*, designed and built by Montgomery Meigs at the Government boatyard at Keokuk, Iowa. in 1884-85.

—Redrawn by Randall Tweet from original plans in the National Archives.

# FOREWORD

The Rock Island District's service to the public officially began in 1866 when the first district office was established in Keokuk, Iowa. Since those early days when the district was almost entirely concerned with maintaining navigation on the Upper Mississippi River, the scope of our capabilities and responsibilities has increased progressively in tempo with the needs and judgments of the ultimate beneficiary of this service—the U S citizen.

Dr. Tweet successfully undertook a prodigious task. He faithfully interpreted volumes of unsorted information to produce a book which should be welcomed by the thoughtful citizen for its readability as well as its instructive value. It describes with authority a variety of activities that collectively constitute a significant contribution to the wise use and preservation of this Nation's water resources.

WALTER H. JOHNSON
Colonel, Corps of Engineers
District Engineer

# PREFACE

The story of the Corps of Engineers on the Mississippi River above St. Louis began shortly after the Louisiana Purchase in 1804 with the first tentative exploration by Major Stephen H. Long. Sporadic at first, the work of improving the channel of the Upper Mississippi became permanent in 1866 with the beginnings of the Rock Island District. This present volume attempts to survey those early years of trial and experiment which led to more permanent improvements, and provide a more detailed account of the growth and development of the Rock Island District from 1866 to the present.

While I have attempted to be accurate and detailed in presenting the basic historical questions of what happened and when, I have consciously expanded the history in three other ways. Because I found that many present employees of the Corps of Engineers were interested in, but had no knowledge of, early techniques and devices of channel improvement, I have spent some time describing *how* things worked. Because I discovered that the public often views the improvements as whims dictated by the self-interest of the Engineers, I have introduced a small amount of economic, commercial, and cultural background to explain *why* improvements took the shape they did. For example, I have attempted to show that the nature of the river bottom and the needs of the steamboats determined the kind of improvements far more than did West Point textbooks or Corps politics. And because I found that, especially in the 19th century, the practical visions of the District Engineers and their civilian employees had as much to do with the success of the work as congressional appropriations, I have considered the men as well as the policies.

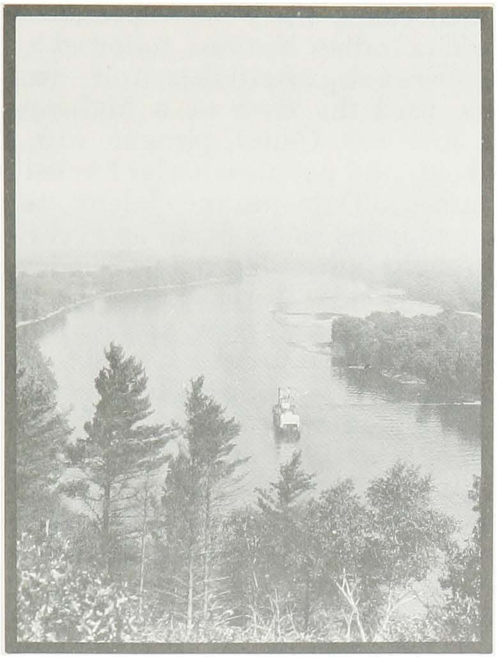
My research discovered many important documents to be missing or destroyed, leaving many minor and several large gaps in the historical record. This frustration, however, has more than been made up for by the generous and understanding help I received from current and past employees of the Rock Island District, all of whom were not only friendly, but open and candid. Robert Clevenstine, Frank Ashton, Raymond Stearns, and Joseph Gerdes provided invaluable supplements to the rather terse information in the *Annual Reports* from 1930 to the present. Mr. William Verlinden spent several months assembling documents from scattered offices and old corners before I began my research, and he pointed me in many right directions. Franklin J. Ryder of the St. Paul District Office graciously opened his files and his research to me.

The excellence of the pictoral record which accompanies my text is almost entirely due to the interest and craftsmanship of three men in the photo lab, Wayne Piatt, Virgil Heitman, and Robert Carstens, who not only helped locate many of the old pictures, but did wonders in resurrecting faded and cracked prints. Thanks is also due to Howard Stamer whose liason work helped pull the whole book into shape.

I owe special thanks to Richard S. Gustafson, Chief, Public Affairs Office, at Rock Island, who guided my work from beginning to end, and to Dr. Jesse Remington, Chief, Historical Branch, OCE, whose excitement was catching, and whose careful reading of the manuscript both as an historian and as a reader unfamiliar with the Upper Mississippi Valley resulted in greater accuracy and clarity.

Many people and organizations outside the Corps of Engineers were also of great help. The Davenport, Iowa, Public Museum contained much information not found elsewhere, as did the Iowa State Historical Society in Iowa City. Mr. Elmer Parker of the Old Military Branch of the National Archives patiently introduced me to the intricacies of those record collections. Mr. William Roba of Davenport, Iowa, served as a research assistant for the sections on floods and flooding. Finally, without a sabbatical leave from Augustana College, Rock Island, Illinois, during the 1972-73 school year, I could not have found the time to complete this history.

The most pleasurable and satisfying part of this project for me has been my gradually developing awareness of the "story" contained within the history of the Rock Island District. My hope is that the reader may find some of this sense of story related in the following pages.



INTRODUCTION

# THE RIVER AND THE ROCK ISLAND DISTRICT

From north-central Minnesota to St. Louis, Missouri, the Upper Mississippi River follows a winding course of some 1260 miles, forming the borders between Minnesota, Wisconsin, Iowa, Illinois, and Missouri. At its source in Lake Itasca the Mississippi is a mere stream, twelve feet wide and two feet deep. By the time it reaches the Falls of St. Anthony at Minneapolis, it has become a navigable river. Between Minneapolis and St. Louis the Mississippi grows ever larger with water from the Minnesota, the St. Croix, the Wisconsin, the Rock, the Des Moines, and the Illinois Rivers, along with several lesser streams.

Finally, just above St. Louis, the Mississippi meets the Missouri, muddy with brown silt from three thousand miles of western plains. At this point the character of the Mississippi changes into the "mile-wide tide, shining in the sun" made famous by Mark Twain. Here it becomes the Lower Mississippi.

The Upper Mississippi is not old as rivers go, but it has worked hard. From Minneapolis to St. Louis it has scoured and polished a 660-mile valley through which it now flows, hemmed in by bluffs and palisades that tower over it by as much as 500 feet. This valley is seldom more than one or two miles wide until the river passes over the Des Moines Rapids near Keokuk, Iowa. In places such as southwestern Wisconsin and northeastern Iowa, the "little Switzerland of America" its residents call it, wooded bluffs reach right to the water's edge, leaving only a width of a block or two for the towns squeezed along the shore.

The distinctive beauty of the Upper Mississippi Valley was noticed and remarked upon by the earliest explorers and trappers. By the middle of the 19th century when steamboat traffic had been established on this stretch of river, it had become fashionable for upper-class families from St. Louis and the East to take the grand tour upriver to the Falls of St. Anthony. George Catlin, the American painter, who spent several seasons along the Upper Mississippi, first urged this tour on the American public in 1835. The first (and just about only) example of cooperation between steamboatmen and railroads was the organization of combination rail-water tours. Tourists were taken by rail from the East Coast to Rock Island, Illinois, where they boarded packets for the trip north. By 1850 the fashionable tourists on the upper decks frequently outnumbered the immigrants packed in beneath.

On this trip up the river, the excursions passed places whose names were as fanciful and varied as their features: Maiden Rock, Catfish Creek,

Point-No-Point, Bogus Bay, Grandad's Bluff, Sugar Loaf, Pig's Eye Island, Beef Slough, Bullet Chute, Dogtown Day Mark, and Royal Arch.

They also passed points where important history had already been made: past Fort Armstrong guarding the foot of Rock Island; past Campbell's Island, where the westernmost battle of the War of 1812 had been fought; past the mouth of the Wisconsin River where, on June 17, 1673, Marquette and Joliet became the first white men to discover the Upper Mississippi; past Fort Crawford at Prairie du Chien, where Colonel Zachary Taylor and Lieutenant Jefferson Davis served together in the late 1820's; past Bad Axe, Wisconsin, where in 1832 the Black Hawk Wars came to an end in an ignoble battle, but one which opened up the whole Midwest to settlers; coming at last to the Falls of St. Anthony, named by Father Louis Hennepin in 1680 on one of La Salle's expeditions.

A trip on the Upper Mississippi became mandatory for the many European visitors who came to America in the 19th century to examine (and comment on) our customs. Anthony Trollope, the English novelist, made such a trip in 1861, during the Civil War. Although he found American manners and customs laughable, as he had expected, he was unexpectedly awed by the River. Trollope made the trip in October, when the hardwood forests along the valley were at their best. Later, in his book on America, he wrote:

> I protest that of all the river scenery that I know, that of the Upper Mississippi is by far the finest and the most continued. One thinks of the Rhine; but, according to my idea of beauty, the Rhine is nothing to the Upper Mississippi. . . . Bluffs rise in every imaginable form, looking sometimes like large straggling unwieldy castles, and then throwing themselves into sloping lawns which stretch back away from the river till the eye is lost in their twists and turnings.[1]

As striking as the beauty of the Upper Mississippi is, however, it does not compare in importance to the working aspect of the river. The Mississippi has always been at work. Long before men arrived to use the river, it had drained the water of four glacial ages, carving at least three separate channels in the process. It formed a drainage basin reaching into 42 of the United States. Sediment from this vast basin over thousands of years formed a broad, flat plain from the original mouth of the river near present-day Cairo, Illinois, over a thousand miles south to the Gulf of Mexico.

When men came, the Mississippi did their work, too. The Indian Nations, followed by the Spanish, French, British, and finally Americans, used the river as a highway for commerce and war. Canoe, pirogue, raft, flatboat, keelboat, and paddle-wheeler hauled lead from the mines at Dubuque and Galena, carried troops and supplies as far north as Fort Snelling, and brought furs and farm produce down to markets at St. Louis. Beginning in the 1830's thousands of immigrants came upriver from St. Louis and Rock Island to debark at Guttenberg and Lansing, Iowa, to settle the rich farmlands of Iowa and Minnesota. Down this river between 1850 and 1919 came virtually every usable white pine log in the states of Wisconsin and Minnesota. Work related to the river built one hundred towns between St. Paul and St. Louis.

In the process of adapting the Mississippi River to do man's work, no organization has played so great a part as the United States Army Corps of Engineers. And on the navigable section of the Upper Mississippi, the very shape of the channel is in large part the result of the activities during the past 107 years of the Rock Island District. To promote the commerce and welfare of the people of the Upper Mississippi Valley, engineers of the Rock Island District have canalized the River by a series of locks and dams, and contained its flood waters by a growing network of urban and rural levee systems. If the tamed river today is not the same pristine river it was when the Sac, Fox, and Ojibway Indians lived along its shores, the long, slack water pools behind the locks and dams, dotted with thousands of willow and oak-covered islands and sand bars have given the present river a new beauty all its own.

Nor has the change all been one way. As the Corps of Engineers has shaped the river, they, too, have been shaped and adapted to the demands of the river. Early in the history of civil works, the Corps recognized that no two waterways were alike and embarked on a policy of decentralization which permitted each district some share in shaping its organization and procedures to suit its own individual problems.

As one of the earliest engineer districts, the Rock Island District has had to find its own way, experimenting, developing new techniques for new problems. The Upper Mississippi, with its sandy bottom and narrow flood plain, has determined both the pace of river improvement and the methods. And like the River, appropriations from Congress for improvement

work have swung back and forth between periods of high and low water, permitting the work of the District to expand, or forcing it to contract.

## THE ROCK ISLAND DISTRICT

The beginnings of the Rock Island District can be traced back to the Act of June 23, 1866, which appropriated funds for the first sustained attempt to improve navigation on the Upper Mississippi River. At this time there were no districts as such within the Corps of Engineers. Early improvements on the Western rivers were assigned by projects rather than districts, permitting several engineer officers to be assigned different duties within the same general area.

Records in the Rock Island Office indicate that until World War I District engineers considered the Rock Island District to have begun in June, 1878, when Congress passed the 4½-foot channel project, the first comprehensive plan to improve the whole 660 miles of river from St. Paul to St. Louis.[2] Col. Alexander Mackenzie, who arrived to superintend the 4½-foot project in 1879, was the first to call himself a District Engineer. But not until January, 1892, when Colonel Mackenzie was assigned all of the Corps operations from St. Paul to the mouth of the Missouri River did the concept of superintending specific projects give way to the idea of supervising an area or district. And not until 1908 did the term "District" come into use as a heading in the *Annual Reports of the Chief of Engineers*.[3]

However, the arrival of Lt. Col. James H. Wilson at Keokuk, Iowa, in August, 1866, did mark the beginning of continuous work on improvement of this section of the Mississippi, and so it seems appropriate to mark that event as the beginning of the future Rock Island District, and to consider Colonel Wilson as its first District Engineer.

Colonel Wilson's orders were to superintend the improvement of the Des Moines and Rock Island Rapids, and to make examinations and surveys toward possible improvement of the Rock and Illinois Rivers. During his 4-year tenure in office, he planned and directed the construction of a lateral canal along the Iowa shore to by-pass the Des Moines Rapids, and began the excavation of a 4-foot channel through the Rock Island Rapids. In the summer of 1870 Colonel Wilson was further ordered to make a preliminary survey for the Hennepin Canal which was to connect the Illinois and Michigan Canal near Chicago with the Mississippi River at or near Rock Island.

In October of 1870 Colonel Wilson was relieved by Colonel John N. Macomb, who had been Superintendent of Western Rivers Improvement since 1866. Colonel Macomb had already, in June, relieved Major Gouvenor K. Warren of his duties on the Upper Mississippi: surveys and experimental improvements of the Upper Mississippi, Minnesota, and Wisconsin Rivers, and construction of a new railroad and wagon bridge at Rock Island to replace the old bridge which had been condemned as a navigation hazard.

In order to be near the construction site of the bridge, Colonel Macomb transferred the work of Major Warren's St. Paul Office and of Colonel Wilson's Keokuk Office to the U.S. Engineer's Office in Rock Island, which had been established by Colonel Wilson as a sub-office in 1869. Colonel Macomb also retained his former responsibilities for snagging operations on the Upper Mississippi, so that with his arrival as District Engineer the duties of the Rock Island Office were vastly broadened in scope and area. Two steamboats, the *Montana* and the *Caffrey*, bought by Major Warren in 1867 and modified for his dredging experiments, were transferred to the Rock Island District, along with several quarterboats and other smaller craft.

In 1872 the deteriorating condition of the Falls of St. Anthony was investigated by a Board of Engineers convened at Minneapolis. As a result of this investigation the Chief of Engineers assigned Colonel Macomb to the task of preserving this important and historic falls. In 1874 Colonel Macomb received additional survey duties connected with the Transportation Routes to the Seaboard project, and with the Survey of North and Northwestern Rivers.

Within ten years of their arrival, then, engineers of the Rock Island District were performing a wide variety of improvements on the Upper Mississippi: constructing a canal and locks, snagging, dredging sand bars, surveying not only the Mississippi but most of its tributaries; chiseling and blasting rock, and seeking ways to save a famous falls.

A similar expansion of duties in the Rock Island District occurred when Major F. U. Farquhar replaced Colonel Macomb as District Engineer in November of 1877. Major Farquhar had been stationed at the U.S. Engineer's Office in St. Paul, in charge of improving the Mis-

sissippi River above the Falls of St. Anthony, and of improvements on the Upper Minnesota, St. Croix and Chippewa Rivers and the Red River of the North. He was also in charge of the projected construction of the first lock and dam on the Mississippi at Meeker's Island. Major Farquhar retained these duties when he assumed those of Colonel Macomb. This gave the Rock Island Office jurisdiction over navigation improvements from Moorhead, Minnesota, on the Minnesota North Dakota border to the mouth of the Illinois River, with sub-offices staffed by assistant engineers at St. Paul and Keokuk.[4]

At the same time that Major Farquhar assumed command of Colonel Macomb's projects, Capt. Amos Stickney, who had been in local charge of the newly-opened canal at Keokuk, was given command of that project. Captain Stickney remained in charge of the Canal until November, 1881, when it was returned to the Rock Island Office. The Canal was put in local charge of Montgomery Meigs, a United States Civil Engineer. Mr. Meigs served well at this post until his retirement in 1926.

The assumption of Colonel Macomb's duties by Major Farquhar marked the first of several times that Rock Island came near to losing its Engineer Office. When he assumed command, Major Farquhar intended to transfer the duties of the Rock Island Office to St. Paul.[5] But he decided to keep the office at Rock Island open until after passage of the next River and Harbor bill, and put Montgomery Meigs in local charge at Rock Island while he remained in St. Paul during the winter.

The change never took place. By April of 1878 Major Farquhar had moved to Rock Island. The Act of June 18, 1878, authorized the 4½-foot channel from St. Paul to St. Louis. On July 15, 1878, all of Major Farquhar's duties above St. Paul were transferred to Capt. C.J. Allen at the U.S. Engineer's Office in St. Paul. Being centrally located for the monumental 4½-foot project, Rock Island retained its Engineers.

Another change in district boundaries occurred shortly after the arrival of Major Farquhar's replacement, Captain Alexander Mackenzie, in June, 1879. Captain Mackenzie had charge of the 4½-foot channel project from St. Paul to the mouth of the Illinois River. In November, 1881, with the transfer of Capt. Stickney to the New Orleans Office, Captain Mackenzie also assumed command of the Des Moines Rapid Canal. During these years the idea of the area between St. Paul and St. Louis as a district gradually developed. Additional sub-offices with civil engineers acting as assistants were set up for sections of the river.

Then in 1884, the Mississippi River Commission, appointed by Congress in 1879 to deal with problems of both navigation and flooding, especially on the Lower Mississippi, was given charge of all improvements below the Des Moines Rapids at Keokuk. In September of 1884 the Commission placed Capt. Ernest H. Ruffner, Corps of Engineers, in charge of improvements from Keokuk to the mouth of the Illinois River. Captain Ruffner opened an office in Quincy, Illinois, to superintend this work, leaving Captain Mackenzie with a shortened St. Paul-to-Keokuk district.

When Captain Ruffner was transferred in 1892, the works of the Quincy and Rock Island Offices were again consolidated at Rock Island under (now) Major Mackenzie.

Two other small changes in district boundaries occurred under Major Mackenzie. The Act of August 11, 1888, extended the upper limit of the Rock Island District from St. Paul to the Washington Avenue Bridge at Minneapolis. Though small in distance this change put Major Mackenzie in charge of planning for locks and dams 1 and 2. This section was returned to the St. Paul District in 1897. The Act of July 13, 1892, extended the lower limits of the District from the mouth of the Illinois to the mouth of the Missouri River.

As was the case with his immediate predecessor, Major Mackenzie made several attempts to move the District Office away from Rock Island. In April of 1881 he requested the Chief of Engineers to change his station to St. Paul because the Rock Island location was "unhealthy."[6] Rock Island was in the middle of a major flood at the time; cholera and typhoid were constant threats, especially to Corps employees working on the river. There had also been a major flood the previous spring with the highest water known on the Upper Mississippi.[7]

Major Mackenzie's request to rent an office in St. Paul was approved. In October, 1881, he requested funds for office furnishings, including an iron safe to hold district records, but apparently the final transfer was not approved.

Again in 1882 Major Mackenzie made several requests to the Chief of Engineers to close the Rock Island Office. In a series of letters from spring through the fall he requested that, for reasons of economy, the Rock Island and Keokuk Offices be consolidated at Keokuk, the "location of the largest and most important individual work under my charge."[8] On one of

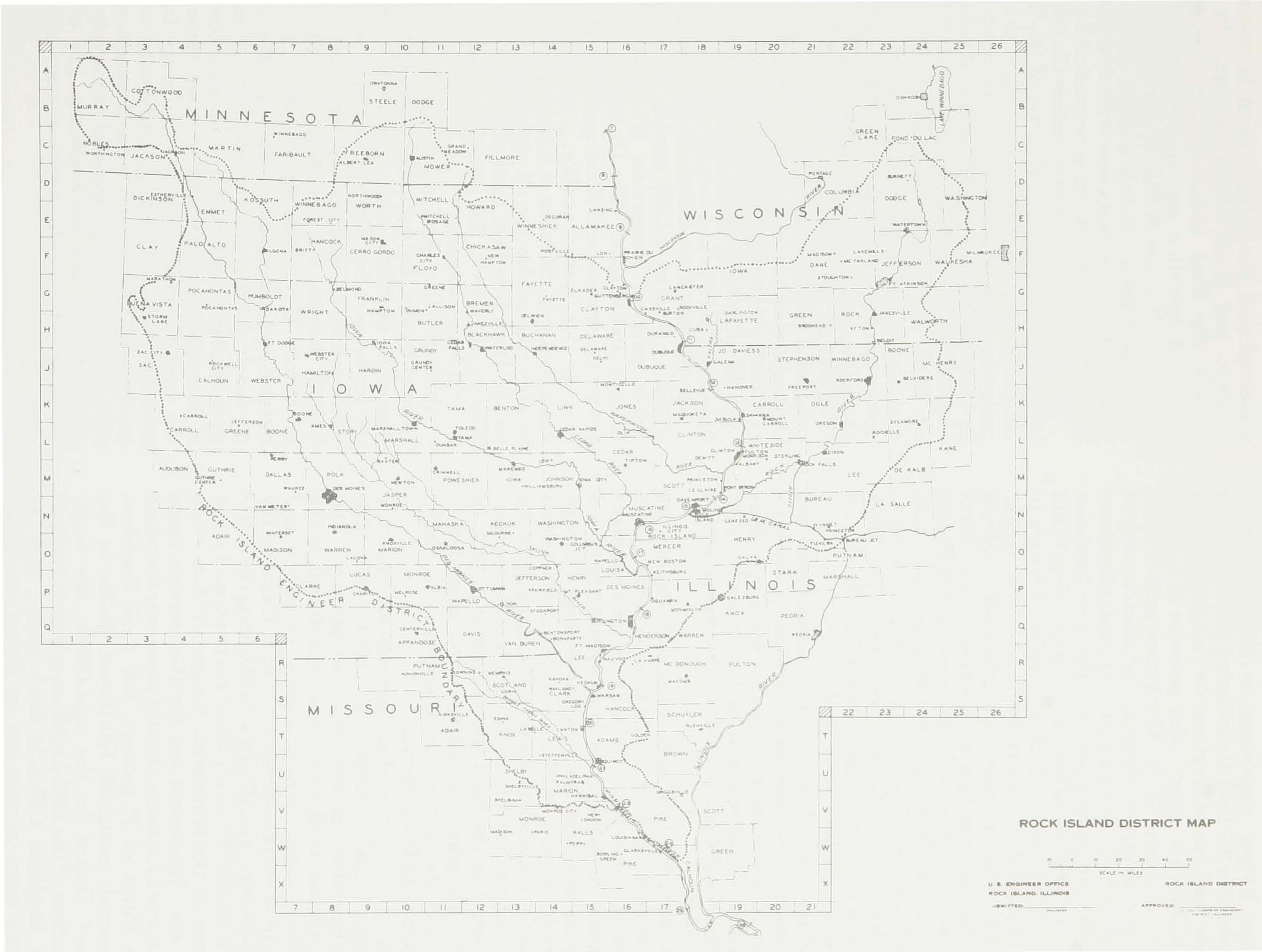



FIG. 1. The present Rock Island District.

these letters requesting a transfer, dated September 23, 1882, there is a pencilled notation from the Chief of Engineers which reads, "Wait until he asks again after passage of R and H Bill."[9] Instead, Major Mackenzie settled down to an extremely cordial and productive stay in Rock Island. He remained as District Engineer for 16 years, far longer than any other Engineer in the Rock Island District. Later, during World War I, he came out of retirement to return to Rock Island as District Engineer for two years.

One other change took place while Major Mackenzie was District Engineer. In 1888 the Corps of Engineers in the continental United States was divided into five divisions in order to facilitate the increasingly complex responsibilities of the Corps' civil works. The Rock Island District became a part of the Northwest Division under Col. Orlando M. Poe.

Since then, because of organizational adjustments, the Rock Island District has been a part of the Western Division, the Upper Mississippi Valley Division, and is presently a part of the North Central Division, headquartered in Chicago.

During the first part of the 20th century the borders of the Rock Island District continued to change somewhat erratically. In 1901 the lower 4 miles of the Illinois and Mississippi Canal which had been built by the Second Chicago District were turned over to the Rock Island District to open and operate. Snagging duties on the Illinois River from its mouth to Peoria were resumed by the Rock Island District in 1907. In 1909 snagging operations were expanded to include the Minnesota, Chippewa, St. Croix, Black, and Rock Rivers.

A totally new kind of duty was assigned the Rock Island District in 1910 when the Lighthouse Board was dissolved. The lighthouse tender *Lily* was transferred to the District, and with it charge of lights and channel markers from St. Paul to Cairo on the Mississippi, as well as the lights along the entire Illinois and Missouri River systems, and a few lights on the Minnesota, Osage, and Gasconde Rivers. Appropriations for this service came from the Lighthouse Establishment rather than the Corps of Engineers, but until President Roosevelt assigned lighthouse duties to the Coast Guard in the mid-1930's, the headquarters of the 13th Lighthouse District were at the Engineer Office in Rock Island, and the duties were carried out by Corps employees using District boats.

In 1911 the Second Chicago District was dissolved and its duties divided between the Chicago and Rock Island Districts. In this division the Rock Island District was given charge of operation and maintenance of the remaining 71 miles of Illinois and Mississippi Canal. It maintained this facility until 1970, when the Canal property was transferred to the State of Illinois for use as a recreation area.

As the complexity of work within the District increased with the authorization of the 6-foot channel project in 1907 and the 9-foot channel project in 1930, its size was gradually reduced. In 1919 the portion of the Upper Mississippi between St. Paul and the mouth of the Wisconsin River was transferred to the St. Paul District. In 1933 the lower limit of the District was moved up to Clarksville, Missouri, 55 miles above the mouth of the Illinois River. Finally, in 1936, shortly after the Rock Island District had completed construction of Lock and Dam 10 at Guttenberg, the boundaries were further reduced to their present size: from just below Lock and Dam 10 to, and including, Lock and Dam 22 at Saverton, Missouri.

The present Rock Island District is a rough triangle covering 52,300 square miles. It includes parts of Minnesota, Wisconsin, Iowa, Illinois, and Missouri. The District is responsible for navigation and flood control (and more recently for water quality, recreation, and wildlife) along 358 miles of Mississippi River. It is also responsible for all rivers and streams which drain into that section of river: the Des Moines, the Rock, the Iowa, the Cedar, and several lesser streams.

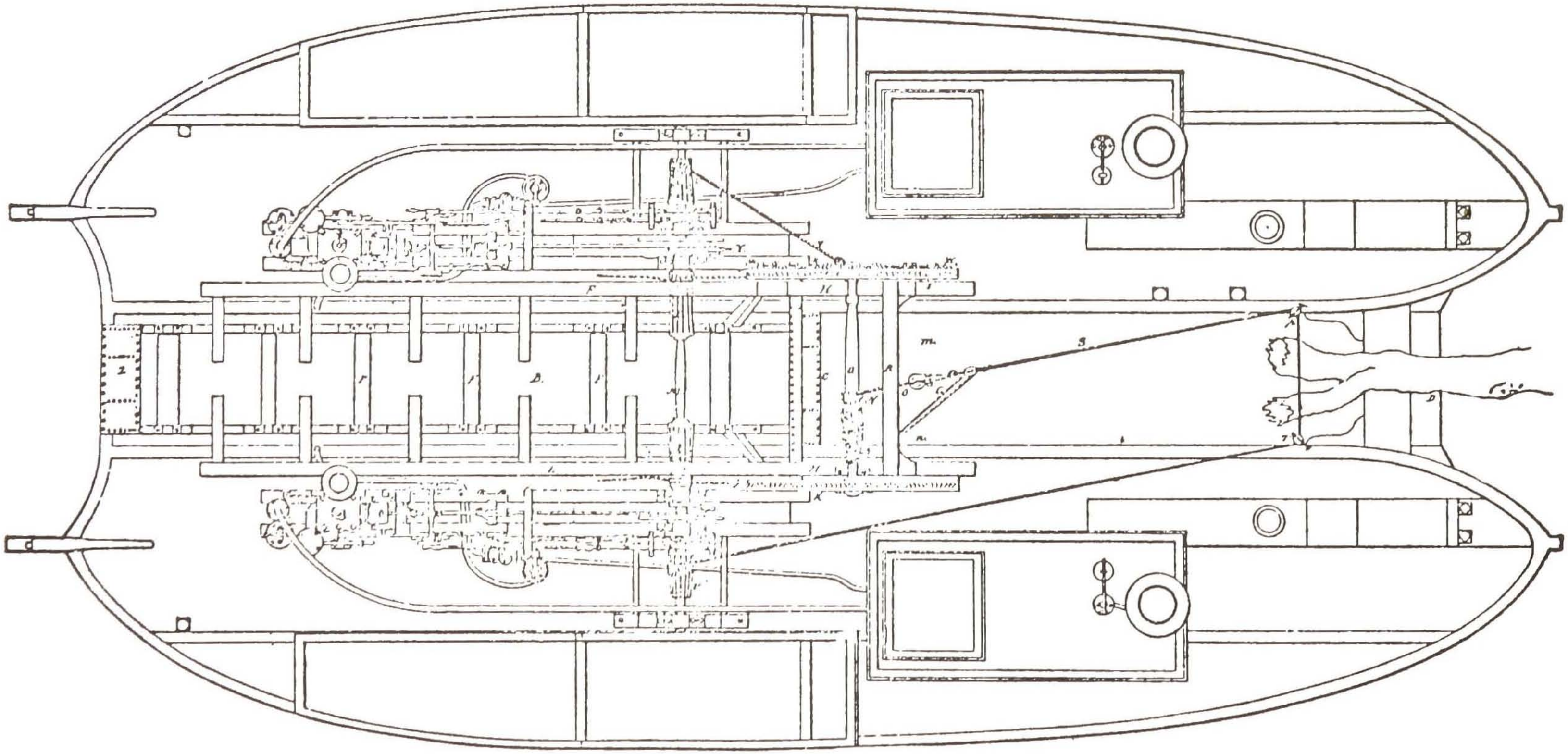
Although the portion of the Mississippi covered by the District today is smaller than it was when the District began in 1866, its duties are far more varied and complex than were the single-purpose projects superintended by Colonel Wilson, Colonel Macomb, and Major Farquhar. The increasing industrial, residential and agricultural use of the Upper Mississippi flood plains, the introduction of multipurpose, basin-wide planning, the development of inter-agency cooperation in water resources, the vast increase in commercial barge traffic since the 1930's, and most recently, our growing awareness of obligations to our limited natural resources, have all contributed to provide new challenges in the never-ending job of arbitrating between the needs of man and the river.

## FOOTNOTES

Introduction

1. Anthony Trollope, *North America* (New York: Alfred A. Knopf, 1951), pp. 143-44.
2. Reports of appropriations compiled by District personnel during this period show early appropriations applied to separate projects. Beginning in 1878, such appropriations are listed under "Rock Island District."
3. Major Warren's report for 1868 (*Annual Report*, 1869, pp. 43ff.) uses the term "District" in referring to his work.
4. The *Annual Report*, 1879, I, p. 690, lists 17 projects under Major Farquhar's supervision. The only project listed for what is now the St. Paul District is improvement of the Yellowstone River above the place where it meets the Missouri River.
5. Major F. U. Farquhar to Chief of Engineers, November 23, 1877, File 71, Letters Received, Record Group 77, National Archives.
6. Lt. Col. Alexander Mackenzie to Chief of Engineers, April 13, 1881, File 71, Letters Received, RG 77, NA.
7. The Davenport *Democrat Gazette*, May 11, 1888, p. 1, quotes Major Mackenzie as saying that this was the first reliably measured flood on the Upper Mississippi.
8. Lt. Col. Alexander Mackenzie to Chief of Engineers, October 9, 1882, File 71, Letters Received, RG 77, NA.
9. Lt. Col. Alexander Mackenzie to Chief of Engineers, September 23, 1882, File 71, Letters Received, RG 77, NA.

FIG. 2. A typical Shreve snagboat, designed especially for use on the lower Mississippi and Ohio rivers.

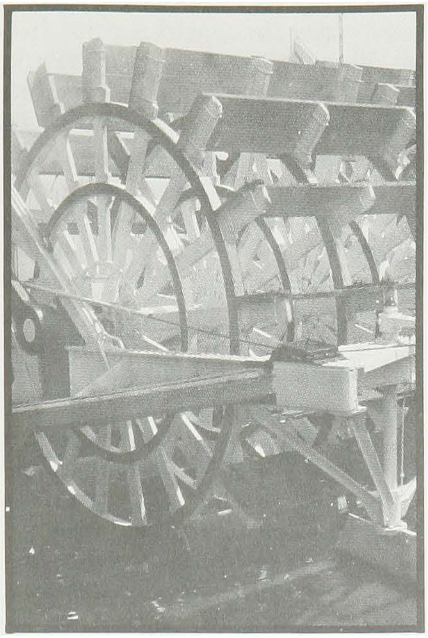


SHREVE'S SNAG BOAT, PATENT NO. 913, SEPTEMBER 12, 1838

AA′: twin hulls
C: inclined bulkhead (iron-sheathed)
D: snag beam (iron-sheathed)
FF: rollers for removal of snag timber

G: main windlass chain
LL: inner engine shaft windlasses
M: engine coupling shaft
N: main windlass chain

R: gallows frame crossbeam
UU′: outer engine shaft windlasses
XX: double steam engines
Z: inclined plane for disposal of snag timber



CHAPTER I

# THE STEAMBOAT VERSUS THE WESTERN RIVERS

Nature was at her most perverse in the design of American rivers. After spreading a grand network of main stems and tributaries across the whole United States east of the Great Plains, she filled nearly every channel with such an assortment of snags, sand bars, shoal water, rocks, rapids, and cross-currents as to make navigation all but impossible for much of the year.

This situation became most annoying after the Louisiana Purchase in 1803. A seemingly limitless country lay waiting to be settled with no way of getting there. Consequently, the first task facing the Westward movement was the improvement of navigation.

Such improvement took two lines of action. American inventors and tinkerers first applied themselves to designing a boat which would overcome the obstacles in the rivers. The result of this attention was the rapid development of the Western steamboat out of the Eastern ship. At its highest development the steamboat was amazingly adept at navigating the unimproved waters of the Ohio and Mississippi Rivers, as well as nearly all of their tributaries. Rivermen talked about the ideal boat which could navigate over a heavy dew.

After the tinkerers had brought the steamboat to its full potential, the only area for further improvement lay with the rivers themselves. At this point the Government, using the Corps of Engineers and the Topographical Bureau as its working arms, entered the picture. Beginning with isolated projects at first, the Corps of Engineers gradually developed the inland waterways into a navigation system that is more in use today than ever before.

The development of the steamboat and the work of the Corps of Engineers in river improvement are inter-related. From the beginning of Corps work on the Mississippi and Ohio Rivers in 1820 down to World War I, the improvements made by the Engineers was designed almost solely to accommodate those floating, self-propelled gingerbread palaces. To understand the work of the Rock Island District, it is first necessary to understand the steamboat.

Within months after the successful trip of the pioneer steamboat *Clermont* in 1807, Robert Fulton and his partner, Robert Livingston, had obtained an 18-year monopoly for their steamboat operation from Governor Claibourne of the Territory of New Orleans. Controlling the mouth of the Mississippi, of course, meant

effectively controlling steam traffic on both the Mississippi and the Ohio.

Fulton's and Livingston's interest in the Ohio and Mississippi had existed prior to the success of the *Clermont*. In developing the steamboat, Fulton had the West in mind from the beginning. The extensive system of waterways tying the East to the Louisiana Purchase via Pittsburgh and Louisville seemed to be the only hope of bringing commerce, civilization, and cities to that rich but roadless territory.

River traffic on the Mississippi had already developed in response to these needs, but only by crude and slow rafts, flatboats, and keelboats. The rafts and flatboats were tacked-together floating piles of wood that were broken up once they had brought their supplies of fur or lead down to New Orleans. Only the keelboats went back upriver again for more than one trip, and they went the hard way, pushed against the current by rows of men with long poles, or pulled along the shore by ropes tied to upstream trees as they went. A keelboat made the trip from New Orleans to the lead mines at Galena in one month. All of these boats were subject to the whims of the river and to uncertain crews of roustabouts.

This early river traffic was never very extensive. Prior to 1817 the whole commerce of New Orleans from the Upper Mississippi was about 20 flatboats of 100 tons each making one trip per year.[1]

Two years after the voyage of the *Clermont* Fulton sent a representative, Nicholas Roosevelt, to Pittsburgh with instructions to make a survey of the Ohio and Lower Mississippi Rivers. In 1809 Roosevelt and his wife floated down the Ohio in a flatboat observing, asking questions, making soundings, and even lining up coal mines for possible future use as fuel stops. Between Natchez and New Orleans the Roosevelts went by rowboat to better observe currents and sandbars. They arrived in New Orleans on December 1.

Rivermen laughed at the idea of a steamboat on these rivers filled with strong currents and shoal water, but Roosevelt convinced the Fulton-Livingston group that it could be done. In the spring of 1811, with plans supplied by Fulton, Roosevelt set about constructing a wooden steamboat at Pittsburgh. This boat was the *New Orleans*, 148.5 feet long with a 32.5-foot beam and a 12-foot draft. Whether it was a sternwheel or sidewheel boat is uncertain. Contemporary accounts support both views. It was a plain boat with a single deck, one cabin divided into two compartments, and a pilot house.

When the *New Orleans* reached Louisville on the night of October 1, 1811, rivermen. had to admit that she worked, but, they said, she would never be back against the current. Roosevelt planned a big dinner for his Louisville hosts. While they were eating, the engines began and before the guests could catch their surprise, they found themselves in the channel, going upstream.

From Louisville the *New Orleans* successfully managed the Falls of the Ohio (the water was high) and steamed toward New Orleans, only to be caught in the middle of the famous "night of horrors," the New Madrid Earthquake of 1811, the greatest earthquake ever to strike North America. Huge waves churned from shore to shore, the water of the Mississippi turned bright red, dense flocks of birds darkened the air, and familiar landmarks disappeared as the River changed its course in numerous places. The *New Orleans* held her own and the next day, with the earthquake continuing, steamed on to New Orleans, reaching there on January 12.

Perhaps the earthquake was a fitting portent for the arrival of this first steamboat on the Mississippi, for within twenty years the steamboat completely changed the pattern of commerce on the River, and made possible settlement along the Mississippi Valley years before roads and railroads came to do the job.

The *New Orleans* was put in the New Orleans-to-Natchez trade. In 1814 she hit a stump near Baton Rouge and sank.

At this point a man entered the picture who was to become a legend both for his contributions to the steamboat business and for his pioneer work for the Corps of Engineers. Henry Shreve had become captain of his own flatboat at the age of 21. In 1810 he travelled to the lead mines at Galena, Illinois, from which he took 70 tons of lead aboard keelboats down to New Orleans, where he cleared a profit of $11,000.

Shreve had examined the *New Orleans* and the second Fulton-Livingston boat, the *Vesuvius*. As a riverman acquainted with Western waters, he knew that these bulky boats were not the answer to easy transportation on the Mississippi.

The problem with these early steamboats was that they were built for deep water, in imitation of seagoing ships. They had rounded hulls with deep holds in which to carry the boilers. Like their ocean-going sisters, they had keels which further increased the draft, without performing any real service for river navigation. And

among other useless trappings, the *New Orleans* had portholes, a prow, and a long bowsprit. Other early steamboats retained masts. Finally, the engines of these early boats were not really powerful enough for the Mississippi current.

In 1814 Shreve became captain of the *Enterprise*, a boat built by Daniel French. With this boat Shreve intended to test another thing he found wrong with Fulton and Livingston: their monopoly on the Mississippi. In defiance of the monopoly, he arrived at New Orleans with the *Enterprise*, which was seized by court order. But at the moment New Orleans was under seige by the British, and General Jackson put Shreve into service transporting troops and material for the war effort. At the Battle of New Orleans, Shreve had charge of one of the field pieces that helped defeat a British column.[2]

Following the Battle of New Orleans, Shreve returned to the East determined to construct a boat not according to preconceived ideas of what a boat should be, but rather, a boat which took into account the nature of the river on which it was to be used. He also determined to use this boat to make another attempt to break the Fulton-Livingston monopoly.

For several months Shreve isolated himself in a Brownsville, Pennsylvania, machine shop. He emerged with a radically new engine. It was horizontal rather than vertical; it had no flywheel and no condensor. It weighed a fraction of other steam engines, yet it developed 100 horsepower. Further, it was a high pressure engine where all previous steam engines had been low pressure.

Shreve had other surprises in store. When the flattened hull, modeled along keelboat lines, rose on the ways, critics asked how the machinery was going to fit. Shreve's answer was to put the boiler and engines on the deck rather than down in the hold. This left little space on the deck for freight or passengers so Shreve put a second deck on top of the first one. He also divided the passenger cabin into separate rooms for the first time. He called these "staterooms" in imitation of the practice on ocean-going ships, but he was the first to begin the practice of naming them after various states.

Shreve's boat, the *Washington*, 400 tons, survived the laughter of critics and a disastrous boiler explosion on its maiden voyage in 1816 to break the steamboat monopoly and open the way for new ideas in steamboat design. Within a few years, the steamboat had reduced transportation charges to about 1/3 of their former keelboat and flatboat level.

Henry Shreve went on to spend most of his life in river improvement. In 1829 at the request of the Government he devised the first snagboat, a double-hulled boat designed to remove sunken logs. Shreve's snagboat, the *Heliopolis*, received the same scorn and laughter from rivermen as his other inventions had, but it soon took care of one of the major obstructions to navigation on the Lower Mississippi. He then went on to undertake the removal of the Red River Raft, a monumental log jam of some 150 miles which blocked navigation on the Red River. Shreve removed this raft in record time. At its head, he founded the town of Shreveport. In 1836-37 he began improvements on the Upper Mississippi which were carried on by Lt. Robert E. Lee.

Meanwhile, the steamboat went on adapting to the demands of the River. One humorist described the later boats as "an engine on a raft with $11,000 worth of jig-saw work."[3] Compared to ocean ships they were flimsy, quickly-built craft with an extremely high accident rate. But during the golden age of steamboating in the 1840's and 50's, they far surpassed their Eastern relatives in the furnishings and decorations of their passenger cabins, in which the packet companies went to great lengths to outdo each other.

For the most part, however, the innovations in design were practical concerns. The special beauty of the steamboat was due to the dictates of the Western waters on which they floated. There was very little theory in the designs, and few boats were built from plans. The builders were free to experiment and innovate.

As the steamboat developed, the hull lost even more depth and grew flat, to move on the water rather than in it. The superstructure grew higher and higher, partly to give the pilot the ability to see ahead of the boat far enough to maneuver and partly to increase carrying capacity. Fully developed, the steamboat had three decks: main, boiler, and hurricane. Above these decks rested a shorter, narrower cabin called the Texas "because it was annexed," and atop this was the pilot house. The tall, handsome smoke-stacks of the boats were designed to carry sparks above the flammable gingerbread decks.

Another distinctive feature of the steamboat was the guards, extensions of the main deck beyond the hull at the sides. At first these extensions served to protect the side wheels. They kept banks and snags away from the

fragile paddles and served as braces for the wheel shafts. Very quickly, however, designers took advantage of this extra space and soon the whole boat was built way beyond the hull, giving the large steamers their characteristic impression of floating just above the water surface with no visible hull.

The steamboat at the height of its development was able to carry incredible amounts of cargo on an unbelievably shallow draft. The first steamboats such as the *Enterprise* could carry about half their weight in cargo. By 1825 the ratio was one to one, and by the 1880's on the Upper Mississippi, a few boats were carrying twice their rated tonnage.

They did this on mere inches of water. The shallow water above St. Louis challenged builders to produce a mosquito fleet capable of going up tributaries that today are difficult for anything but a canoe. In 1867, the year following the start of the Rock Island District, two boats were constructed for the Upper River traffic which drew 16 and 18 inches of water, though they displaced 220 and 280 tons respectively.

If these boats were flimsy and dangerous, their profits were more than enough to make it worthwhile. A boat might cost its owner $50,000, but it could pay for itself in two trips up and down river. In the 19th century the average life of a sea-going vessel was 20 years, that of a whaling ship was 40 years. But down to 1850, before the coming of inspections and licensing, the average life of a steamboat was less than five years. At the beginning of 1849 only 22 of the 572 steamboats operating on Western waters were more than five years old.[4]

While the steamboat developed rapidly on the Lower Mississippi and on the Ohio as far up as Louisville, the beginnings of steamboat traffic to St. Louis and further north took several years longer. Here the River was shallower, the current swifter, and the sandbars more frequent. Rivermen assumed that no steamboat could ever navigate the rapids at Keokuk and Rock Island. In addition, the Upper Mississippi Valley was only sparsely settled until the 1840's.

Not until 1817 did a steamboat make its appearance on the Mississippi above the mouth of the Ohio. In August of that year the *Zebulon M. Pike* steamed up to the foot of Market Street in St. Louis. The *Pike* was the second-smallest steamboat documented on the Mississippi, a small craft of 31 tons.[5] It had one smokestack and was so underpowered that it required supplemental poling in strong currents.

Then in 1819 the *Western Engineer*, constructed and commanded by Major Stephen H. Long, went up the Missouri River on an exploring expedition. When it returned to St. Louis in 1820 Major Long took the boat upriver to the rapids at Keokuk.

The *Western Engineer* was not only the first steamboat on the Upper Mississippi, it was also undoubtedly the strangest. It was a small boat, 75 feet long with a 13 foot beam, drawing 30 inches of water. Her bow was constructed to resemble a scaly serpent rising out of the water, appearing to carry the boat on its back. The smokestacks were so arranged that smoke and steam came out of the serpent's mouth. The churning stern wheel further heightened the effect of a sea serpent carrying men on its back. *The Western Engineer* awed several Indian villages, which was perhaps one of its purposes. Those not frightened by the river dragon could be impressed by the three brass cannon mounted on the roof of the cabin, or the portrait of a white man and an Indian shaking hands.[6]

Until 1823 rivermen assumed that steamboats could not pass the Des Moines Rapids at Keokuk. In that year, however, a boat named the *Virginia* made the trip, carrying a prototype steamboat cargo of military supplies, tourists, businessmen, Indians and soldiers. The *Virginia*, 120 feet long, with a 22-foot beam and a 6-foot draft, was little larger than the keelboats.

Fortunately for historical record, one of the passengers on the *Virginia* was Giacomo Beltrami, the Italian exile and explorer who was at the moment interested in discovering the source of the Mississippi. Beltrami kept careful notes of the whole trip. Also on board was Great Eagle, a Sauk Chief, and Major Lawrence Taliaferro, the Indian Agent from Fort Snelling.

The *Virginia* left St. Louis on May 2, 1823. Beltrami was amused by the fact that as soon as the boat left the dock, Great Eagle, who had come to St. Louis to confer with General Clark (of Lewis and Clark fame), removed his uniform and made the rest of the trip "*in status quo* of our first parents."[7]

If the *Virginia* set a record for speed on the Upper Mississippi, it was only because she was the first boat there. On the 9th of May while the boat was taking on wood, Beltrami went for a walk in the woods. Returning to find the boat gone on without him, he walked upstream until he came around a bend and found her stuck in one of her frequent encounters with a sandbar.

A bit further upstream Great Eagle got into an argument with the captain over which channel to take. He grew angry, and swam ashore where some of his people had been following the boat's progress along shore. The next day when the boat arrived at Fort Edwards at the foot of the Des Moines Rapids, Great Eagle was already there.

After running the Des Moines Rapids with difficulty and "great good luck" the *Virginia* continued upriver. Beltrami found this section of the river a place of incredible beauty. The river "reflected the dazzling rays of the sun like glass; smiling hills formed a delightful contrast with the immense prairies, which are like oceans."[8]

On May 10th[9] the *Virginia* arrived at Fort Armstrong at the foot of the Rock Island Rapids on the lower tip of Rock Island. Her arrival caused excitement among the soldiers stationed there, who saluted the arrival with cannon. But on leaving the fort, the *Virginia* stuck fast on a rock in the upper rapids, and according to Beltrami, "had not Providence come to our aid and swelled the waters of the river for two days, the steam-boat would perhaps have remained nailed to the rock."[10]

The *Virginia* reached Fort Snelling at the mouth of the Minnesota River before turning around and coming back. That same summer in June she made a second trip between St. Louis and the Falls of St. Anthony.

For the next 20 years, steamboating on the Upper Mississippi developed slowly. Galena lead mines contributed some traffic. In 1827 7,000,000 pounds of lead came down to St. Louis from Galena, but some of this was still carried by keelboats. Most steamboats above St. Louis at this time were chartered by the Government to transport military supplies to the string of forts along the River, or were hired by the American Fur Company.

By 1840 the populations of Iowa and Illinois began to boom. Between 1840 and 1860 Iowa went from a population of 43,112 to 674,913, while Illinois went from 476,183 to 1,711,951. Industry increased, too. By 1855 Moline, Illinois, was well known as a center of farm manufacture. John Deere plows were shipped by steamboat to Dubuque, Burlington, Muscatine, and Keokuk, Iowa.

Increased population and industry brought increasing steamboat service. Arrivals of steamers at St. Louis from the Upper Mississippi went from 143 in 1841 to 663 in 1846. By 1854, the year the first railroad bridge across the Mississippi was begun at Rock Island, the Rock Island levee saw as many as 175 steamboat arrivals per month, with the average being 20 per week from March to December. In 1857 Davenport, Iowa, had 1,587 steamboat arrivals, 960 of these having Davenport as a terminus.[11]

Even the tributaries of the Upper Mississippi River developed extensive steamboat traffic prior to the Civil War. By 1853 five steamboats were operating commercially on the Minnesota River, going to Mankato on regular schedules. Several boats were built specifically for the Chippewa River trade.[12] Somewhat less regular service developed on the Iowa, Maquoketa, Cedar, Des Moines, and Rock Rivers by 1860. Between 1850 and 1860, forty boats operated on the Des Moines River. In 1858-59, two of these maintained a schedule between Des Moines and Fort Dodge, Iowa.

During this same period the logging industry grew to its status as an American legend. The two sawmills on the River in 1840 grew to nearly one hundred by the end of the Civil War. During the early 1860's lumbermen began experimenting with the use of steamboats to take log and lumber rafts all the way downriver. Prior to this their use had been limited to Lake Pepin, where they were needed to push the raft through the still current. Soon steamboats were designed specifically for the lumber trade. The first of these "raftboats" was the *J.S. Van Sant*, built by the Van Sant family of Le Claire, Iowa.

The use of barges to overcome the shoal water of the Upper Mississippi also began before the Civil War. Pushing one or two barges, a steamboat could add significantly to the tonnage hauled. By 1866, according to the riverman Stephen Hanks, nearly every commercial steamboat used barges.[13] Many of these were being used for the bulk shipment of grain.

When Colonel Wilson and his assistants arrived on the Upper Mississippi in 1866, steamboats had become a regular and important part of the Valley economy. Nevertheless, steamboating was still slow, irregular, highly seasonal, and dangerous because of the two rapids, the shifting channel, and an unpredictable low water season.

These hardships were bearable before the railroads brought competition, but by 1866 improvement was needed. The boat builders had performed wonders in adapting their boats to the River. But the design had been carried to near-perfection. Further improvements would have to lie with the Mississippi itself.

At this point and for this reason the Corps of Engineers arrived to begin a series of projects to improve navigation on the Upper Mississippi River.

## FOOTNOTES

Chapter I

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2. Mildred Hartsough, *From Canoe to Steel Barge on the Upper Mississippi* (Minneapolis: University of Minnesota Press, 1934), p. 45.
3. Louis Hunter, *Steamboats on the Western Rivers* (Cambridge: Harvard University Press, 1949), p. 62.
4. *Ibid.*, p. 100
5. William Petersen, *Steamboating on the Upper Mississippi* (Iowa City, Iowa: State Historical Society of Iowa, 1968), p. 78.
6. Richard G. Wood, *Stephen Harriman Long* (Glendale, California: Arthur H. Clark Co., 1966), pp. 62-65.
7. J. C. Beltrami, *A Pilgrimage in Europe and America*, Vol. I (London: Hunt and Clark, 1828), p. 127.
8. *Ibid.*, p. 151.
9. Some sources put this date on May 25.
10. Beltrami, p. 159.
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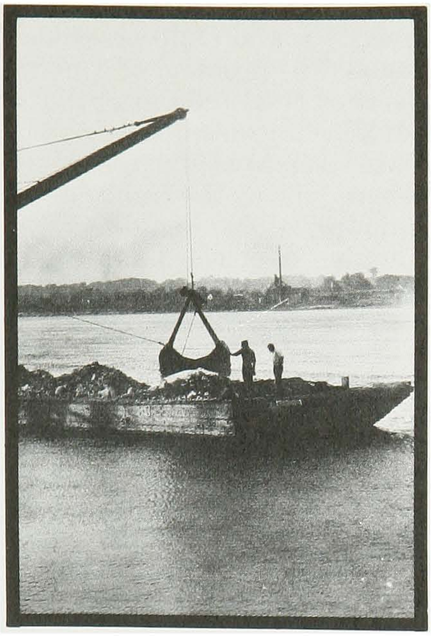
13. *Ibid.*, p. 116.



CHAPTER II

# THE ENGINEERS GO TO SCHOOL ON THE MISSISSIPPI

From George Washington's Continental Army to the construction, operation, and maintenance of locks and dams serving commercial barge and towboat traffic on the Upper Mississippi River may seem to be an illogical leap for any organization, but that is one of the many directions the United States Army Corps of Engineers has taken in its 200-year history.

On June 16, 1775, the day before the Battle of Bunker Hill, the Continental Congress established a corps of engineers, consisting of a Chief Engineer and three assistants, to aid in designing sieges and fortifications.[1] Abolished in 1793 when the war with England was over, the Corps of Engineers was reorganized on several brief occasions during the 1790's when war threatened. Finally, on March 16, 1802, the Jefferson administration created a permanent Corps of Engineers. Sixteen officers and four cadets were directed to take station at West Point, New York, which was constituted as a military academy.[2]

In 1816 a half-dozen officers were added as topographical engineers, though they were not strictly limited to surveying and mapping. These topographical engineers began the first surveys of the interior of the United States. One of these new engineers was Lt. Stephen H. Long, who was assigned to the Southern Division under General Andrew Jackson, and who was to take part in many of the early explorations of the Upper Mississippi Valley.

The expansion of the Corps of Engineers from fortifications to civil works was both natural and, in a young country with vast public lands but limited industrial resources necessary. By training on civil projects during peacetime, engineers could prepare themselves and keep ready for wartime needs. At the same time, during the first part of the 19th century civil engineers were in extremely short supply. For a long time, West Point was the only school in the country which taught courses in engineering. It remained the leading engineering school in the country until the Civil War. If the West was to be settled it had to be reached. The only engineers available to do the job of building the roads and canals, charting routes for the growing railroad industry, and improving navigation on the inland waterways were those West Point graduates.

This early emphasis on transportation helped to formulate the long-lasting Corps policy of single-purpose projects on the Mississippi. Not until the Mississippi River Commission was established in 1879 did projects for purposes other than navigation begin.

Congress had early gotten the Federal

Government into the business of public works. The first session in 1789 passed an act providing that "a lighthouse shall be erected near the entrance of Chesapeake Bay."[3] In 1802 President Jefferson ordered $34,000 to be spent for public piers on the Delaware River.

In addition, most of the Colonies had surplus land. Maryland refused to sign the Articles of Confederation until there was evidence that the new government would have control of these unsettled lands. In 1780 New York set a precedent by ceding her claims. Others followed, and by 1802 Georgia, the last state, ceded her lands to the Federal Government. With the Louisiana Purchase the following year most of the present United States passed into the public domain.

However, even Presidents such as Jefferson, Jackson, and Van Buren, who saw the need for internal improvements had doubts about the constitutionality of federal assistance in such projects. Jefferson suspected, and his successor Madison was assured, that an amendment would be needed to permit the Federal Government to enter the field of public works. The expeditions of Lewis and Clark, and the later explorations of Lt. Zebulon Pike, Major Stephen H. Long, and Lt. John C. Fremont did serve a number of civil purposes, including taking stock of national resources, but all under the guise of national defense. Several Presidents, most notably Polk and Pierce, were opposed to Federal public works and succeeded in cutting appropriations to a minimum.

But the need for such improvements remained obvious and in 1818 the House of Representatives considered what improvements could be made as national defense measures. President Monroe's Secretary of War, John C. Calhoun, was instructed to write such a report. Calhoun went far beyond the official request and produced a carefully-thought-out and detailed scheme for building roads and canals and for improving navigation on inland waters.

This report played a major part in determining the role of the Corps of Engineers in civil works for Calhoun's entire plan was based on the premise that the surveying, planning, and supervision of construction of these projects would be wholly in the hands of the Army Engineers. Calhoun's report also smoothed the way for projects which, while having military value, were also of obvious commercial value as well.

Caught between increasing need for improvements and recurring questions of constitutionality, Federal navigation projects on the Mississippi and Ohio proceeded fitfully and piece-meal. The problem of constitutionality was not settled until 1866, after the Civil War. Only then did the improvement of navigation on the Upper Mississippi begin in earnest.

Nevertheless, within the limits of small and random appropriations, Engineers had performed a number of surveys and experimental projects between St. Louis and St. Paul by the time Colonel Wilson arrived in 1866.

Much of this early surveying and experimenting was performed by Topographical Engineers.[4] As has been mentioned, these Engineers were appointed in 1816, as a part of the larger Engineer Corps. On July 2, 1818, a separate Topographical Bureau was created, but still within the Corps of Engineers. As a result of increasing civil improvement projects, the topographical engineers were removed from the Corps of Engineers on July 5, 1838, and formed into a separate and equal Corps of Topographical Engineers under Col. J.J. Abert.

On August 1, 1838, Secretary of War Poinsett transferred all civil works directed by the United States to this new Corps of Topographical Engineers, reserving the Army Corps of Engineers for fortifications and other military construction. Although this dividing line was not strictly observed, most of the improvements on the Upper Mississippi between 1840 and 1860 were supervised by Topographical Engineers. General G.K. Warren's early work on the Mississippi was as an officer in this Corps.

In 1863 the two Corps were again united as a single Corps of Engineers under Major General A.A. Humphreys. The Corps of Topographical Engineers had only two Chief Engineers from 1838 to 1863: Colonel Abert and Major Stephen H. Long.

Major Long was the first Engineer to explore the Upper Mississippi. Between 1816 and 1818 he made surveys of the Illinois, Fox, Wisconsin and Minnesota Rivers.[5] On July 9, 1817, Major Long with a party of 15 set out from Prairie du Chien, Wisconsin, in a six-oared skiff to examine defense sites along the valley. He reached the Falls of St. Anthony, then returned downriver to St. Louis. He stayed a few days at Fort Armstrong, which he considered an ideal fort, and then became the first of a series of Engineers to lose a contest with the Des Moines Rapids when his boat, much battered by the rocks, sprang a leak as he neared Fort Edwards.[6]

The first direct effect of the Calhoun report came in 1820 when Congress appropriated $5,-

000 for the first Corps of Engineers survey, an examination of the Ohio and Mississippi Rivers from Louisville to New Orleans to "determine the most practical means of improving their navigation." The report of this survey, made by Generals Bernard and Totten, suggested "clearing and snagging" as the primary means of improvement.

In 1822 Congress passed the first appropriation for river and harbor work, a sum of $22,500. There was no appropriation in 1823, but in 1824 Congress appropriated $115,000 for improvement work, the first of what were to become regular annual appropriations for "rivers and harbors." In 1824 Congress also passed the General Survey Act "to procure the necessary surveys, plans, and estimates, upon the subject of roads and canals."[7] This act was the most important direct result of the Calhoun report. It gave the President authority to employ officers of the Corps of Engineers to make surveys "as he [the President] may deem of national importance."[8]

To administer this Act, President Monroe appointed a Board of Engineers for Internal Improvement, consisting of Chief Engineer Macomb, his assistant General Bernard, and John L. Sullivan, a civil engineer. Topographical Engineers from the Topographical Bureau were attached to the Board, and a vigorous campaign to survey projects got under way.

Prior to 1829, however, few of these appropriations reached the Upper Mississippi. The Ohio and Lower Mississippi Rivers were more settled and more closely connected with markets to the East. Although there was some trade as far north as St. Louis, steamboats were still in the process of developing enough power to brave the swifter currents above St. Louis. The Upper River was still dominated by keelboats and flatboats. The snagboat which Henry Shreve invented in 1829 was for use on the Lower Mississippi only.

Appearances on the Upper Mississippi by Corps officers during the 1820's was incidental to other purposes. Major Long had taken the *Western Engineer* up to Keokuk in 1820 just for show. In the spring of 1823 he again passed along the Upper Mississippi on an expedition to discover the source of St. Peter's River (later the Minnesota River). Major Long and his party came by way of Chicago, "a few miserable huts inhabited by a miserable race of men."[9] From here they cut across the wilderness to Fort Crawford at the mouth of the Wisconsin River, and then went by land up the right bank of the Mississippi into Minnesota. On this trip Major Long saw the advantages of a waterway connecting the Great Lakes with the Mississippi, and became the first Engineer to suggest a canal connecting the two.

Not until 1829 did the effect of the General Survey Act of 1824 reach the Upper Mississippi. Late in 1828, Chief Engineer Gratiot ordered Lt. Napoleon B. Buford, 3d Artillery, on Topographical Duty, to "make reconnaissance and survey of the Des Moines and Rock River rapids, with a view to overcoming the obstacles to the navigation of the river at those points."[10]

Using the assistance of soldiers from Fort Armstrong, Lieutenant Buford began his survey at the Des Moines Rapids on February 13, 1829, making both a topographical map and a profile of water levels at the surface. Lieutenant Buford's map was too general to be of much use to Colonel Wilson when he arrived in 1866, but it was amazingly accurate considering the fact that when Lieutenant Buford made the survey, the Mississippi was covered with one foot of ice and nine inches of snow.

In his report Lieutenant Buford noted that with the exception of 11¼ miles at the Des Moines Rapids and 13¾ miles at the Rock River Rapids (changed to Rock Island Rapids after 1860), the whole of the river from St. Louis to the Falls of St. Anthony was navigable for 8 months each year by boats of 4½-foot draft. Because of the rapids, however, navigation was reduced to the 4 months of high water each year.

Lieutenant Buford examined two alternatives to improving the channel at Keokuk and Rock Island: constructing lateral canals around the rapids and excavating the existing channel to a depth of 5 feet. He concluded that the problems involved in lateral canals, especially around the Des Moines Rapids, were "almost insurmountable"[11] and recommended using coffer dams to expose the rock in shallow places for blasting. His estimates of the ease with which the improvement of these rapids could be achieved proved to be overly optomistic (a common failure for the next 40 years).

Lieutenant Buford supported his recommendations for improvement by pointing out both military and commercial advantages. Foremost among these advantages was assistance to the Galena lead traffic. By 1829 the lead mines at Galena were employing 10,000 workers. The Port of Galena was by far the busiest steamboat landing north of St. Louis.

The report was published as a House Docu-

ment, but Congress took no action. For the next seven years there was no Corps of Engineers activity on the Upper Mississippi.

Lieutenant Buford's activities on the Upper Mississippi were not ended, however. As with many other Engineers who came to work on navigation improvements, he fell in love with the area. In 1833 his parents and family moved from Kentucky to Rock Island, where his father opened the first store on Main Street of the young town. The family built a mansion in Rock Island (now the Tri City Jewish Center), and over the years provided their share of river pilots.

## LT. ROBERT E. LEE AND THE RAPIDS

Corps of Engineer activities resumed on the Upper Mississippi in 1835 when the river began cutting a new channel close to the Illinois shore opposite St. Louis. Above and below the St. Louis waterfront bars began forming and threatening to cut off river traffic. In 1836 Congress appropriated $15,000 to build a pier above St. Louis to deflect the current back toward the Missouri shore and scour the old channel. Chief of Engineers General Gratiot asked Henry Shreve to draft a plan for the pier. At the same time, he requested Shreve to make recommendations for improving the Des Moines and Rock River Rapids.

In the summer of 1836 Shreve went north in a small government steamboat to look at the rapids. He was not familiar enough with either rapids to make recommendations without study. He visited the Rock River Rapids first, threading the mazes of the upper rapids until he knew them well. Then he charted a channel down through middle of them, and planned which edges to cut off.[12]

Shreve recognized a different set of problems at the Des Moines Rapids. These rapids consisted of a single rather uniform layer of rock which made the whole stretch shallow and without the characteristic ripples to indicate obstructions. Shreve concluded that a channel cut through these rapids would be useless at night, and even during the day would require buoys and rapids pilots who knew where the improved channel was. Instead, Shreve recommended excavating a channel 90 feet wide along the Iowa shore. In this way the improvement would not interfere with present navigation and more important, the shore line would form one side of the channel and serve as a guide for pilots.[13]

Shreve returned to St. Louis and finished plans for the St. Louis pier, but too late to begin work during the 1836 season. He might have been assigned to complete these projects had not a young Engineer officer on duty with OCE in Washington volunteered for the St. Louis post. Lt. Robert E. Lee (who went on to fame in the Civil War) found official Washington unexciting and was looking for something more challenging. General Gratiot had taken a liking to Lee and gave him the post requested. As an assistant to Lieutenant Lee General Gratiot assigned Second Lt. Montgomery Meigs, a young West Point graduate of 21. (Lieutenant Meigs later supervised the construction of several important Corps projects, including the Capitol dome and the Washington Aqueduct.) Lieutenants Lee and Meigs set out for St. Louis in August, 1837. General Gratiot had already been there to make a personal inspection of the work to be done. He was a native of Missouri and had long been interested in the improvement of the Mississippi River. In giving this post to a young, untried Engineer he showed great faith in Lieutenant Lee's potential.[14]

Lieutenant Lee was not impressed with St. Louis at first. "It is the dearest and dirtiest place I was ever in," he wrote to his close friend Andrew Talcott, "Our daily expenses about equal our daily pay."[15] But he grew to like the place during his three seasons there, and the citizens of St. Louis grew to like him. In 1838 when Congress cut off appropriations for completing the St. Louis pier, Lieutenant Lee found himself in the middle of a fight between St. Louis political factions, each blaming the other for the Congressional action. True to Corps tradition, Lee refused to take sides. The Missouri *Republican* of October 2, 1838, wrote of him:

> The character of the Superintendant forbids the idea that he would make such a declaration for electioneering purposes, in fact, we believe he has deported himself throughout our election as every government officer should, but as very few at this day do, taking no part in the contest.[16]

In 1838 and 1839, Lee brought his growing family along to his St. Louis post.

The Act of March 3, 1837, appropriated an additional $35,000 for work on the St. Louis pier. The same Act appropriated $40,000 for continued improvement of the Mississippi River above the mouth of the Ohio and of the Missouri Rivers. With these funds Lieutenant Lee was directed to resurvey the Des Moines and Rock River Rapids, to determine a plan for their improvement, and to begin such improvement as funds would allow.

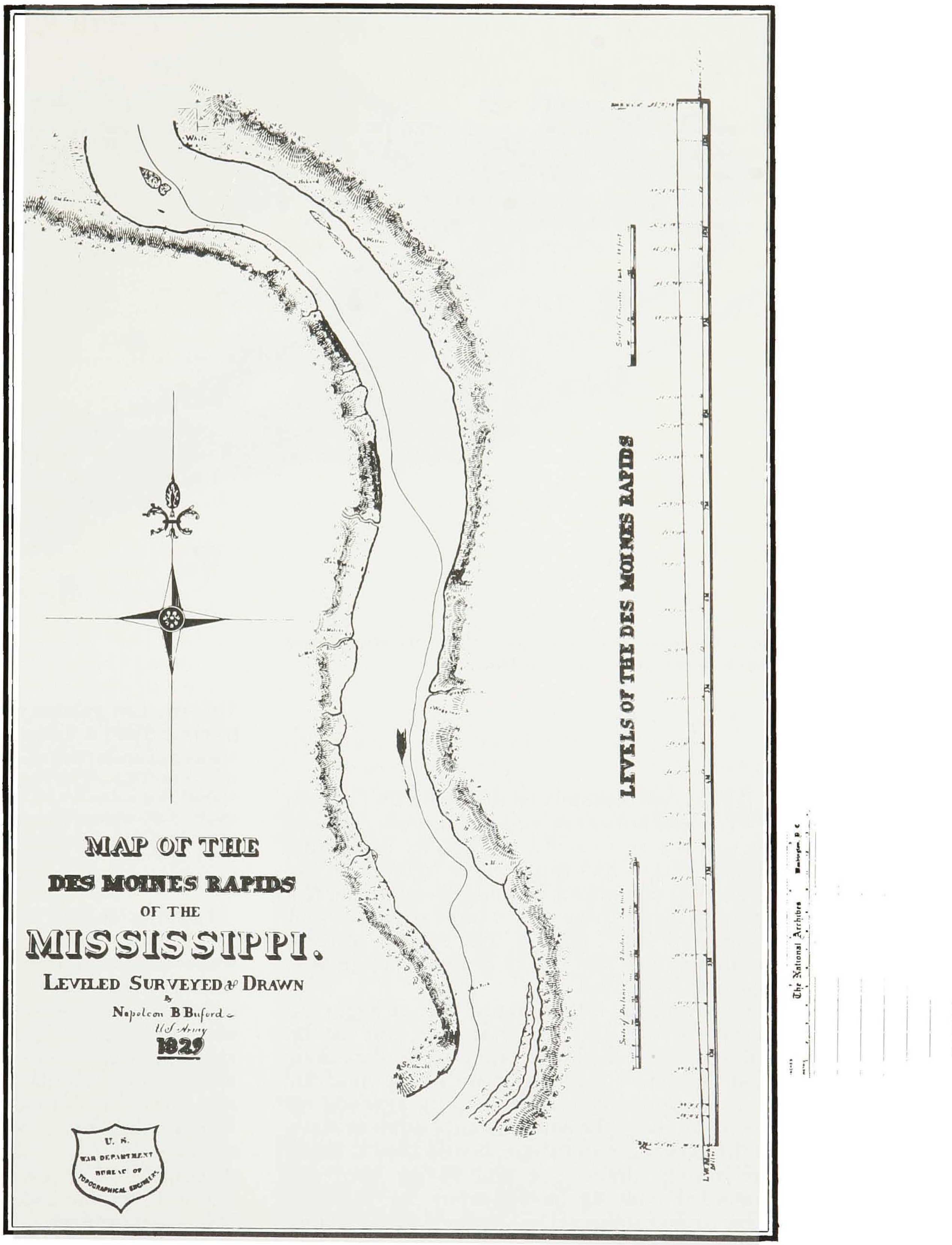



FIG. 3. The first Engineer map of the Des Moines Rapids, drawn by Lieutenant Napoleon Buford to accompany his 1829 survey report.

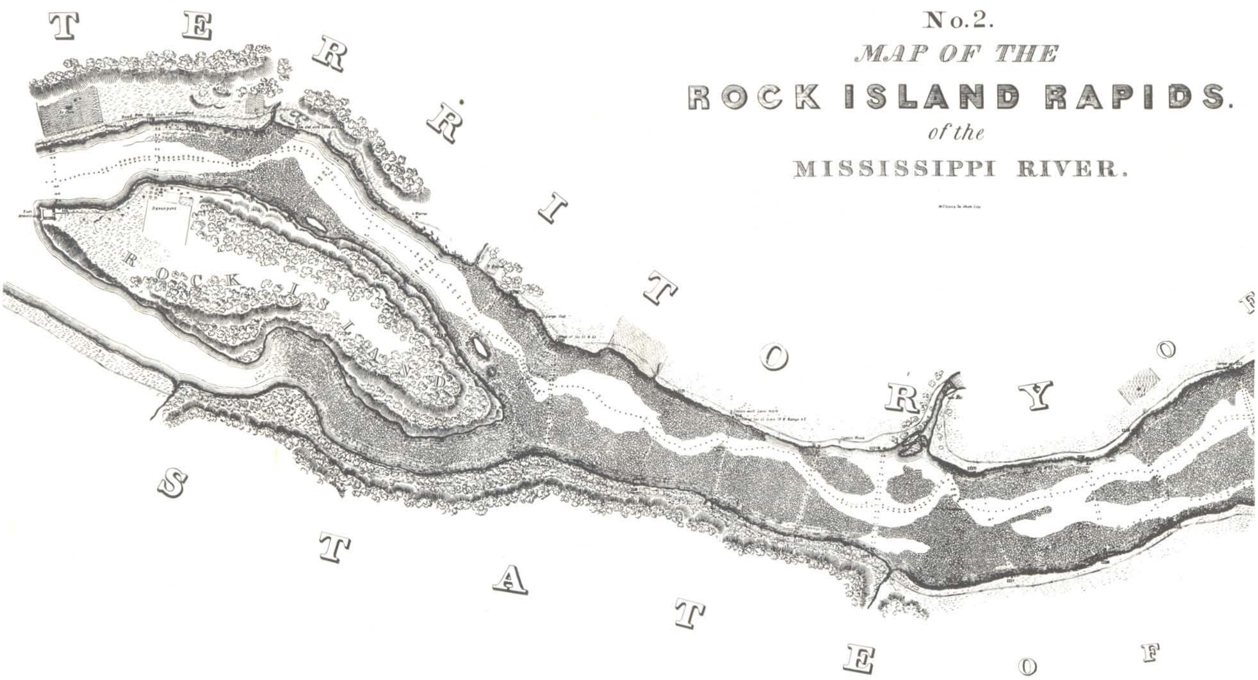



FIG. 4. Lieutenant Robert E. Lee's map of the Rock Island Rapids, based on his survey in 1837.

Almost immediately on arrival in St. Louis in 1837, Lieutenants Lee and Meigs made plans to survey the two rapids. Earlier, in Louisville, Henry Shreve had turned over to them all the boats and equipment he had assembled for the project. Using these and a hired crew Lee and Meigs proceeded upriver. The captain of their small steamer was Henry Shreve's son-in-law, Captain Morehead.

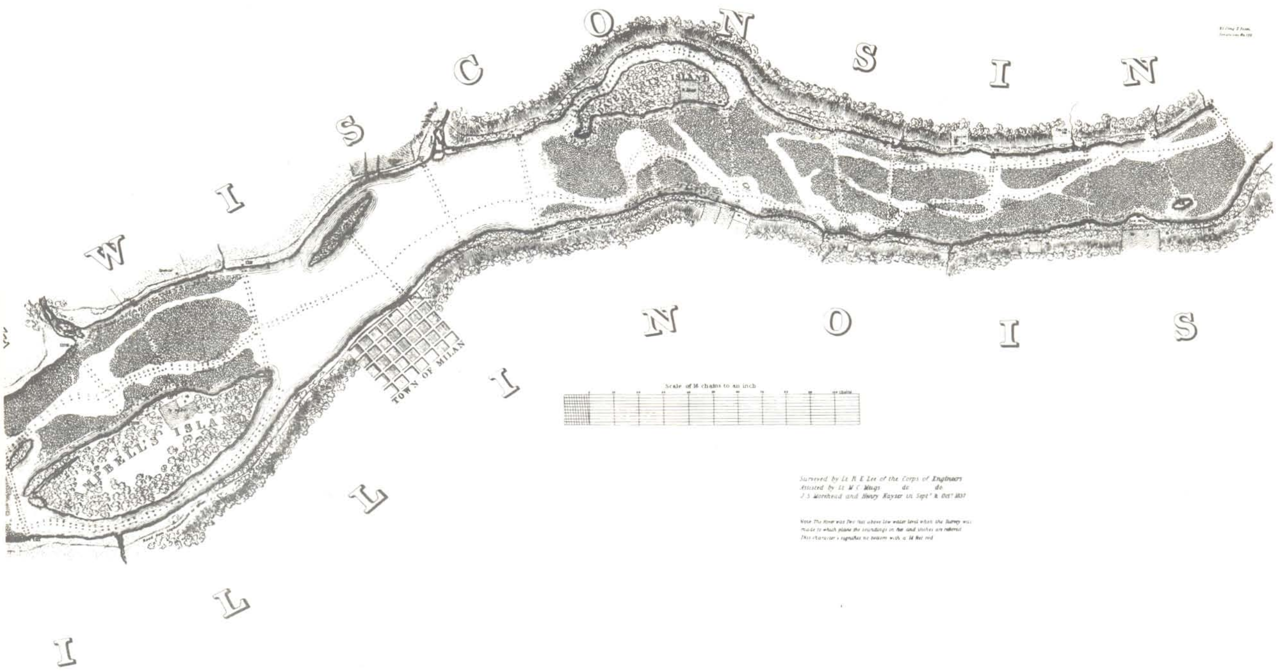
Lee's original intention had been to begin the survey at the Rock River Rapids, but as the party reached the lower rapids at Keokuk their boat furnished concrete proof of the need for channel improvement by running aground on the rocks. Since the boat was impossible to move at the existing water stage, Lee decided to begin the survey there. Lee and Meigs used the grounded boat as headquarters for the first three or four miles of the survey. After this they camped along the Iowa shore as they moved up the Rapids.

Lee's letters during this period capture the flavor of frontier life. In a letter to Andrew Talcott, Lee relates that at one encampment, having filled a vacant cabin with his men,

> Meigs and myself took up our blankets and walked a short mile to the City of Des Moines composed of the worst kind of a small log cabin which contained the Proprietor and the entire population. Here we were kindly received and all accommodated with the softest Puncheon on the floor. How much I would tell you of the same city, its puncheons, dwellings and inhabitants, but I must look to my limits.[17]

Leaving the steamboat behind, Lieutenant Lee and his crew moved to the upper rapids where they found a greater degree of comfort and civilization at Davenport and the brand new town of Stephenson (later Rock Island). For accommodations Lee moved his party onto a steamboat that had been wrecked and abandoned on the rapids. The bottom had been torn out, but the two upper decks were above water. Here Lee and his men lived well, fishing for blue catfish over the side of the boat in the evenings.[18] "I assure you," he wrote to Talcott, "we were not modest, but fell without difficulty into the manners of the country, and helped ourselves to everything that came our way."[19]

By the time Lee returned to Keokuk high water had floated his boat free and he returned to St. Louis by October 11 to draw up maps of the




rapids and write the reports of his surveys. He also drew up plans for improving the St. Louis waterfront, generally using Shreve's recommendations, but by the time they were finished the season was too advanced to begin work, and Lee requested permission to return to Washington and his family for the winter. Before leaving he made preparations for the following spring by contracting to have a steamboat and four flatboats built.

Lieutenant Lee's report on the two rapids was somewhat more detailed than Buford's, but he was equally mistaken in the ease with which he assumed the improvements could be done. Lee's conclusions were consistent with Buford's, that improvement of the main channel at Keokuk and Rock Island was the best solution. He rejected Shreve's suggestion of a lateral canal at the Des Moines Rapids because it would involve an excavation of stone three times as great as would be needed to improve the natural channel to a width of 200 feet and a depth of 5 feet. Lee felt that cutting a channel through the Rock River Rapids would be even easier. These rapids were not consistently shallow. The difficulty was the natural channel's tendency to twist and turn as it threaded its way through the chains of rock. Lee felt that the Rock River Rapids could be improved by cutting off some of the projecting points of rock at short turns and narrow places, and by placing buoys to guide boats through the crooked channel.

Lee estimated that to complete the entire project would require $189,622 at the Des Moines Rapids and $154,658 at Rock Island, an estimate that turned out to be short by almost five million dollars. In concluding his report Lee pointed out the necessity of the rapids improvement which would open up a whole country above the rapids that was "daily increasing by a constant stream of emigration."[20] Twenty boats of over 150 tons each were already in regular service on the Upper Mississippi.

In planning and carrying out improvement of the rapids and the St. Louis pier, Lieutenant Lee was doing pioneer work on the Mississippi. Prior to this, Federal activities on the River had been limited to cutting and removing trees along the shore and removing snags from the channel.

When Lee returned to St. Louis the following May to begin the actual work of improvement,

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he had been promoted to Captain. He remained in St. Louis to superintend the channel project there and sent his new assistant, Horace Bliss, to the Des Moines Rapids to take charge of that improvement.

Bliss soon experienced an aspect of the Mississippi that would plague every Engineer involved in river improvement throughout the 19th century. The seasons of high and low water were extremely variable, forcing men to work when the River wanted them to work rather than when they were prepared to do so. The high water Bliss found when he arrived in Keokuk in the middle of May should have dropped, but Bliss and his crew were kept idle for weeks as the river continued to rise.

Just as Lee gave up for the season, the river fell unexpectedly. Lee and Bliss got a small crew together and returned with them to the Des Moines Rapids, where they began cutting rock out of the Illinois Chute. Work was no sooner under way when cold weather hit on October 10. Captain Lee kept on the hardiest of his men, more than doubling their wages, but on the night of October 16 the river froze, followed by snow the next day, and he was forced to abandon work on the rapids without really having had a chance to prove his plan. This work in the fall of 1838 did not improve the channel much, but it did convince Captain Lee that a channel could be cut.

The Act of July 7, 1838, appropriated $20,000 for the Missouri River and for the Mississippi above the mouth of the Ohio, and $1,000 each for surveys of the Rock River with a canal to Lake Michigan, and for a survey of the Des Moines and Iowa Rivers. But the whole $20,000 was diverted to Shreve's snagging operations, and the tight money situation resulting from the "specie circular" scandal and the Panic of 1837 made further Congressional appropriations impossible. During the 1839 season Captain Lee used what money was left from previous appropriations to finish the St. Louis project, limiting his work on the rapids to the Lower and English Chains of the Des Moines Rapids. With Horace Bliss in charge again this season, work went ahead better than the previous year. Captain Lee came to the Rapids about the middle of July to supervise the work, taking time to make a trip to Galena where he happened on several old West Point friends and enjoyed soda water and ice cream "four times a day."[21]

By the end of the 1839 season Bliss had removed nearly a whole reef at the Lower Chain and had opened a passage 50 feet wide and 4 feet deep, removing some 2,000 tons of stone. After August 27 Chief Engineer Totten, General Gratiot's successor, sent Lee on various surveys and inspections on the Ohio, Mississippi, and Missouri Rivers.

The method developed by Lee and Bliss for blasting rock under water was used with improvements and variations throughout most of the rest of the rapids improvement work. Lee placed iron tripods over the rock to be blasted. On this tripod he built a platform for workmen and as a guide for the drills. The men then drilled a 1¾-inch hole down through 2/3 of a single rock layer. (Lee had found it impractical to remove more than one stratum at a time.) A charge of one-half pound of powder was placed in a tin tube, and the rest of the tube filled with sand. The tube was prepared and placed in the hole immediately on removing the drill. It rose above the water and was supported by the tripod. The effect of such an explosion was merely to split the rock so that it could be removed in large pieces. In this manner, blasting could be done almost as economically as on shore.[22]

Congress again failed to vote further appropriations in the spring of 1840, and when Lee returned to St. Louis at the end of July, it was only to survey the previous work and advise his assistant, Henry Kayser, who had been hired by the City of St. Louis to complete the waterfront project. No further work was done on the two rapids.

Henry Kayser stuck to Lee's plan of improvement and eventually the bar that had been forming in front of St. Louis washed away, and the channel along the Illinois shore that Captain Lee had closed off filled in and later became East St. Louis, Illinois.

One interesting sidelight of Lee's years on the Upper Mississippi is a persistent story among local historians that the young Lieutenant was so impressed with the country along the River that he invested in, and laid out, a town site along the shore near the present city of Davenport, Iowa. The basis for this rumor can be found in *The History of Davenport and Scott County Iowa*, by Harry Downer (Chicago: S.J. Clarke, 1910). Downer reprints an excerpt from a journal of an early Rock Island resident, Suel Foster, who remembered taking a trip down the Iowa (then Michigan Territory) side of the Mississippi from Davenport to Muscatine, and seeing stakes laid out for future towns along nearly the entire fifty miles. Six miles downriver from Davenport he reports coming across the

town of Iowa "laid out by Captain Robert E. Lee and William Gordon, (the same Lee afterwards the great Rebel general.)" Suel Foster also reported that Captain Lee was mayor of that future town, though he was absent when Foster was there, busy "surveying the route of the great river."

Little confirming evidence can be found for this account, and the 1836 date which Foster gives for his trip is two years before Lee spent any time in this area. But it remains just possible that Captain Lee's work on the Upper Mississippi did give him a previously unreported title: "Mayor" Lee.

## SCATTERED SURVEYS, EXAMINATIONS AND EXPERIMENTS

During the next fifteen years from 1840 to 1855 only minor surveys and improvements were carried out on the Upper Mississippi. A survey of the Rock River and the Rock River Haven (a chain of 4 lakes in and near the present city of Madison, Wisconsin), authorized in 1838 was completed by Captain T.J. Cram of the Topographical Engineers. This was a preliminary investigation for a project to connect the Rock River by canal to Lake Michigan, with the chain of lakes serving as feeders for the canal. Cram outlined the rapids and bars that would have to be removed in order to make the Rock River navigable.[23]

Perhaps the only survey on the Upper Mississippi that resulted from a romance was made in 1841. John C. Fremont, a young Lieutenant with the Topographical Engineers in Washington, met Senator Thomas Hart Benton from Missouri. Benton's expansionist ideas fired Lieutenant Fremont's zeal. Fremont has already spent some time on the Upper Mississippi in 1836-37, when he had assisted the distinguished French scholar, J. N. Nicollet, with explorations at the source of the Mississippi.

Lieutenant Fremont fell in love with Jessie Benton, daughter of the Senator. In order to separate the couple, Senator Benton arranged to have Fremont assigned to the survey of the Des Moines River which has been authorized in 1838. Lieutenant Fremont carried out a survey of 203 miles of the Des Moines River in July of 1841. Although Fremont made a map of the Des Moines River (never published), he seems to have paid more attention to the flowers and wildlife along the way. His report contains extensive descriptions of plants and geographic features.[24] Lieutenant Fremont returned to Washington, where he married Jessie Benton.

In 1843 the Corps of Topographical Engineers adopted a divisional structure which placed Major Stephen H. Long at Louisville, Kentucky, as Superintendent of Improvements on the Mississippi, Missouri, and Arkansas Rivers, and on the Ohio below the falls at Louisville. Major Long remained here until 1858, when he moved his headquarters to St. Louis.

Under Major Long's direction the first harbor improvement work on the Upper Mississippi was begun. In 1844 Congress appropriated $7,500 for deepening the harbor at Dubuque to accommodate steamers of the largest class. A small amount of dredging was done in 1844 by Joshua Barney, United States Agent,[25] but the work was not completed with amount appropriated, and no further funds were authorized until 1853. The Mexican War in 1846-47 stopped all appropriations and drew many of the Topographical Engineers away from civil works.

Part of the $7,500 appropriation for the Dubuque harbor may have been used to build a dredge boat, the *Devaseur*. Plans for the boat exist in the National Archives (see illustration) and indicate that the boat was built, but other scattered records from this period do not confirm this. The *Devaseur*, as the illustration shows, was a "ladder dredge" using scoops on a belt to make shallow cuts in mud, sand, gravel, or other soft material. It was self-propelled by a steam winch attached to lines on opposite shores. It pulled itself along these lines, cutting a long, narrow channel. If this boat was actually built, it was the first piece of floating plant constructed by the Corps specifically for Upper Mississippi River improvements.

In 1850 Congress appropriated funds for the famous Mississippi Delta Survey. Under the supervision of Capt. A.A. Humphreys and Lt. H.L. Abbot, the Corps of Engineers began the first truly scientfic survey and examination of nearly the entire Mississippi River Valley. When Humphreys' report was finally filed and published in 1861 as the *Report Upon the Physics and Hydraulics of the Mississippi River*, it immediately became a standard resource and a model of imitation for succeeding reports. Work on this report gave Captain Humphreys a close look at the Des Moines and Rock Island Rapids, and his advice became valuable to Colonel Wilson when he began improving the rapids in 1866.

Renewed interest in the improvement of navigation on the Upper Mississippi resulted in

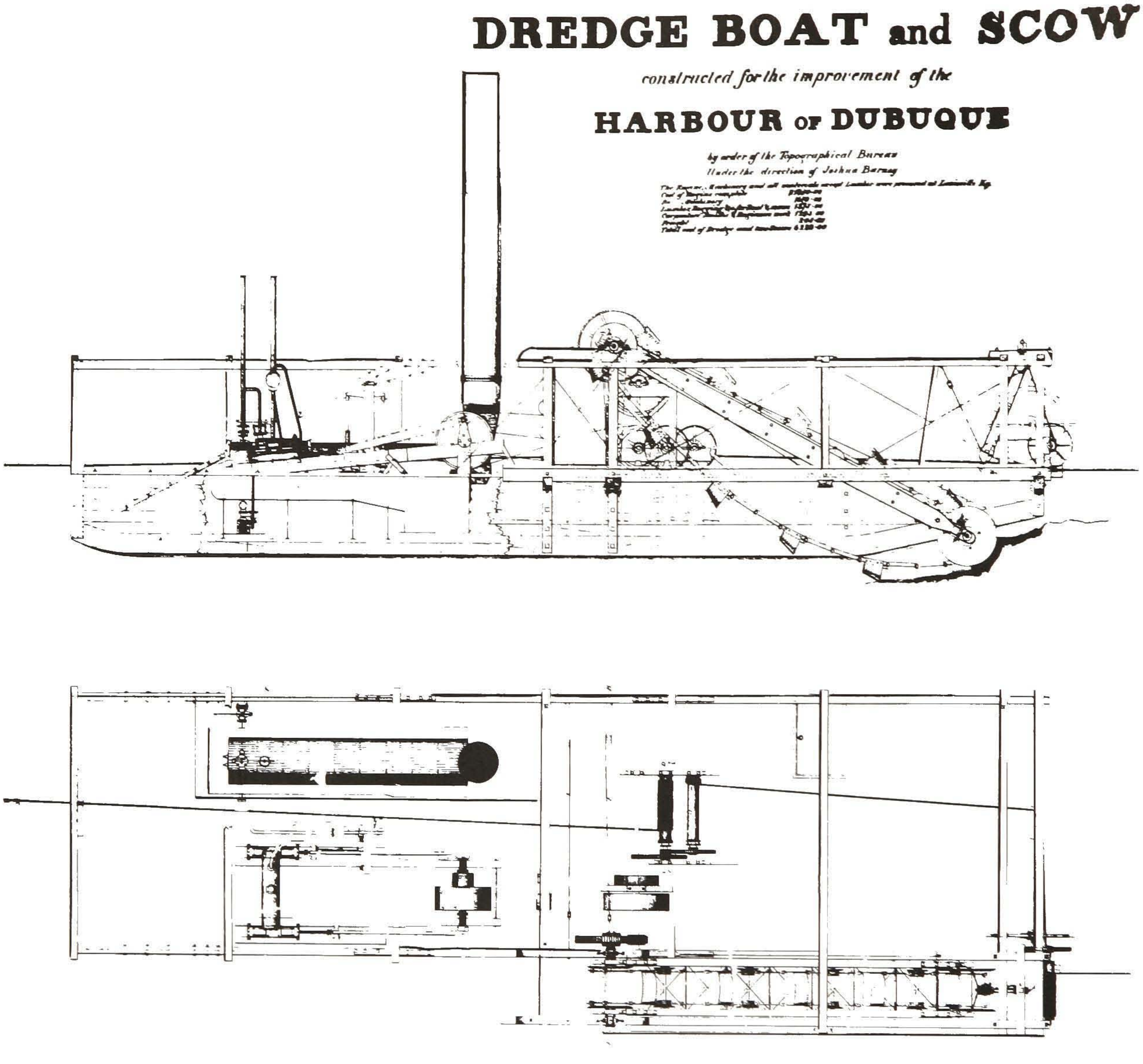



FIG 5 Plan of the ladder dredge *Devasseur*, designed by United States Agency Joshua Barney in 1844 for work on the Dubuque harbor.

—*National Archives*

the passage of the Western Rivers Improvement Act in 1852. This Act placed river and harbor work more firmly under the direction of the Corps of Engineers. Congress appropriated $90,000 for improving navigation below the rapids, $100,000 for work on the Des Moines and Rock Island Rapids, $15,000 to complete dredging of the harbor at Dubuque, and $30,000 for improvement of the Illinois River. The last item was a Federal response to the Illinois and Michigan Canal which ran between Lake Michigan at Chicago to the Illinois River, and which had been completed by the state of Illinois in 1848. However, due to high water and problems finding contractors, only $15,000 of the total appropriation was spent in 1854, all of it on rock excavation at the two rapids.

The Western Rivers Improvement Act also brought Major Long to St. Louis as Superintendent of Western River Improvements. The improvement of the Dubuque harbor begun in 1844 was resumed on July 1, 1853, again under local charge of Captain Barney. The work consisted of cutting a channel from the harbor across the

Mississippi to the main channel along the Illinois shore.

Using $7,500 of the money appropriated, Captain Barney supervised construction of a ladder dredge along lines similar to the 1844 *Devaseur*. This dredge was named the *George W. Jones*, "Dredge No. 1;" A similar dredge (No. 2), named the *Gopher*, was built under the direction of United States Agent C.A. Fuller for service on the Illinois River in 1853.[26]

Captain Barney was also put in charge of improving the Rock Island Rapids, to be done by contract. He advertised in both local and Eastern papers for the work to begin early in October, but no acceptable offers were received. Similar difficulties continued to be a problem on the Upper Mississippi. Much of the work was of such an experimental nature that few contractors had equipment to do the work or the knowledge necessary to make reasonable bids. And no contractor was eager to invest in expensive, specialized equipment, considering the past history of Congressional appropriations.

Major Long also detailed one of his assistants, Lt. G.K. Warren, to make a third survey of the Des Moines and Rock Island Rapids. This was the first of many services Lieutenant Warren performed for the Corps of Engineers on the Upper Mississippi.

Warren began work on the surveys in July 1853 and completed work in November. His work took this long partly because of high water and partly because of a lack of cooperation from Captain Barney and Major John Floyd[27] who were supposed to assist him, but it was also because of the careful and deliberate manner in which Warren worked. The Warren Report published in 1854 was far more detailed and useful than the earlier ones by Buford and Lee.

Because of continued support among rivermen for Shreve's recommendation for a lateral canal around the Des Moines Rapids, Lieutenant Warren made a particularly close examination of the existing shore channel along the Iowa side of the River. That channel had only 10 to 12 inches of water in places and was used wholly by "lighters," small, horse-drawn boats used to relieve the large packets of their cargo so that these steamers could pass the rapids in low water. During the low water season, boats with a draft larger than 24 inches could not get over the rapids.

Lieutenant Warren anticipated that such a lateral canal as suggested by Shreve might eventually become the permanent method of improving the Des Moines Rapids, but recommended that present work be limited to deepening the natural channel. Such an improvement would be immediately useful, while a canal would give no improvement until the whole was completed—no sure bet considering past appropriations.

Warren agreed with Buford, Shreve, and Lee in feeling that the Rock Island Rapids was a far easier problem than the Des Moines Rapids. Low water on the Upper Rapids gave a 2½-foot channel naturally, and this had been raised another 10 inches by damming the small channel separating Rock Island from the Illinois shore. The real dangers of the Rock Island Rapids were the crookedness of the channel and the swift, unpredictable currents.

The need for improvement on the Upper Mississippi was shown by the fact that in 1853 seven steamers had been wrecked between Keokuk and St. Paul, two of them on the Rock Island Rapids and one on the Des Moines Rapids. Major Long calculated that the average loss of these boats, including wages and freight, was $50,000 per boat.[28]

Contract work on both rapids began in August of 1854 and continued until November. Major John Floyd replaced Captain Barney as United States Agent supervising these projects. Although the contractors did not assemble as many men as had been hoped for, they did good work and in the short three-month season significant improvement was noted. Using the drilling and blasting methods developed by Lee, contractors at the Des Moines Rapids worked on the English Chain at the points designated on Warren's map as Centre and Brown's Patches. These points were almost entirely removed, giving Centre Patch a low water depth of six feet and Brown's Patch a depth of five feet. Contractors at the Rock Island Rapids worked at Campbell's and Sycamore Chains. At Campbell's Chain a channel 100 feet wide and 4 feet deep was obtained.

The problems encountered with the advent of serious work on the rapids soon made those in charge aware of how optimistic early estimates had been. A single rock in Brown's Patch required two men four days to drill a hole 23 inches deep and dulled 72 steel points. At Campbell's Chain four men took two weeks to cut off 2½ feet of rock projecting into the channel, even though breakwaters were used to protect the men from the current.[29]

Major Floyd foresaw that at the present rate improvement of the Rapids might take

"forever."[30] He suggested that in 1855 appropriations should be doubled, work should be carried on during the two months of low water in early spring using India rubber suits for the men, and that contractors should run three shifts around the clock.

Although the two months of low water never materialized in 1855, work progressed well because of the introduction of powerful new steam equipment. Wrought iron drills with cast steel cutter heads four to six inches wide, and a new steam chisel with massive iron cleaver heads were put into operation, along with new boats designed to support them . This new equipment was apparently designed by Major Floyd and built by the contractors. Adapting to this new fleet delayed the beginning of work in 1855 until September 15.

During the 1855 season a new problem developed in connection with contract work. The Corps of Engineers found it increasingly difficult to find contractors to do the work, and the contractors themselves found it impossible to hire enough men to complete their contracts with the Corps. The reason was competition from railroad companies who were building westward as rapidly as possible. The Corps of Engineers had been involved in the railroad craze in the East in 1830's in much the same capacity as they were now on the waterways. Now railroad fever had affected most of the general public in the Upper Mississippi Valley.

This fever may account for the fact that the significant improvements being carried on by the Engineers, though they had been requested by people of the Valley for many years by memorials to Congress, pressure on Congressmen, and river improvement conventions, now went all but unnoticed in the local newspapers. The Davenport *Gazette* of June 9, 1853, noting the new appropriations for rapids improvement, claimed not to feel much interest in it, now that the "certainty of direct Railroad communication with the East was assured."[31] Part of the excitement over the railroads involved land speculations; towns would be made by the railroads as they had been by the River. Another cause of the excitement was the realization that railroads would give the Upper Mississippi Valley transportation to Eastern markets; they would no longer be tied exclusively to St. Louis.

Public sentiment, then, was pro-railroad in 1855 when the first bridge across the Mississippi, the Chicago, Rock Island and Pacific Rail Road Company Bridge, opened for traffic. Steamboatmen, however, sensing an end to their transportation monopoly, complained bitterly about the bridge as an obstruction to boats in the channel. In 1856 the steamboat *Effie Afton* struck a bridge pier, wrecking both boat and bridge. The ensuing legal tangle involved Abraham Lincoln as a lawyer for the railroad company, and ended with no firm conclusion as to how much of an obstruction the bridge really was.

Major Floyd in his 1856 report to Long, now a Lieutenant Colonel, took an especially dim view of the bridge:

> It has been deemed proper by your orders not to work on the Rock Island rapids with the balance of the appropriation. Indeed, it were useless to do any more work there as long as the bridge remains to obstruct the navigation. I look upon that bridge, as now located and constructed, being situated at the narrowest point on the rapids, where the current has the greatest velocity, and the piers at an angle to the current, to be a greater obstruction to the navigation of the Rock Island rapids than all the balance of the rapids besides.[32]

Major Floyd may have had a point. Of the 1,667 boats and rafts passing the Rock Island Bridge in 1857, 55 collided with the structure.

The other Corps projects on the Upper Mississippi in 1855-56 fared as poorly. The Dubuque harbor project grew more and more complicated. On August 21, 1854, a Board of Engineers of Lake Harbors and Western Rivers authorized a survey at Dubuque to find a site most suitable for a bridge and "causey" [causeway]. The bridge (railroad) was to go from Dubuque to Dunlieth (now East Dubuque), Illinois. Colonel Long assigned this survey to J.C. Jennings, United States Agent in charge of the harbor improvements at Dubuque, on May 31, 1855.

The need for harbor improvements at Dubuque was increasing rapidly. Commercial statistics listed 672 steamboat arrivals at Dubuque in 1854, bringing 97,633 tons of goods with a value of almost five million dollars. Exports from Dubuque reached 11,736 tons in 1854.[33]

Agent Jennings immediately began making changes in both the causeway and harbor plans. He determined to change the location of the causeway and construct it with dirt from the bluffs rather than from river islands as originally called for, and he made many deviations from the original harbor lines. At the same time, a "Dubuque Harbor Company" had been formed on February 27, 1855. This joint stock company of private Dubuque businessmen owned land near the harbor and proposed causeway. A controversy began between the Corps and the company over rights-of-way, stopping the work.

Jennings failed to respond to Major Long's letters of inquiry during the summer of 1855, and when Long made an inspection tour to Dubuque on October 22, he found the harbor still unimproved. Disagreements were settled the following spring, but no further appropriations were forthcoming.

Work continued through the 1856 season on the Des Moines Rapids with the new steam equipment performing well. In 1856 a new blasting technique involving "galvinism" was put into use. Major Floyd reported to Colonel Long that now he could "set off a line of blasts of almost any length simultaneously."[34] But work on the Des Moines Rapids came to a close unfinished at the end of the season. Later, in response to a Congressional inquiry about a possible lateral canal around the Rapids, Floyd reported that the natural channel was adequate, and that all the engineers who had seen it felt that it could be easily expanded "to suit the exigencies and requirements of commerce, even fifty years hence; which will be far different from now."[35]

Although the Act of August 16, 1856, appropriated an additional $200,000 for improvement of the Des Moines Rapids, no further work was done on either rapids after the 1856 season. Only a small section of each rapids had been improved. The Keokuk *Whig* on September 6, 1856, reported that there was still only 20-22 inches of water on the Des Moines Rapids. A President opposed to Federal civil works and the impending national crisis served to dry up appropriations.

When the Civil War began in 1861 the Engineer officers who had learned and practiced their craft on the inland rivers were called to put their training to military use. All of the Engineers assigned to the improvement of the Upper Mississippi following the War had served the Union well. Major G.K. Warren brought back an especially distinguished war record. Historians credit his planning at the Battle of Gettysburg with being decisive in winning that battle.

FOOTNOTES

Chapter II

1. Ralph P. Thian, *Legislative History of the General Staff of the United States Army 1775-1901* (Washington, GPO, 1901), p. 485.
2. 2 stat. 132.
3. 1 stat. 53, discussed in Frank Smith, *The Politics of Conservation* (New York: Pantheon Books, 1966), p. 3.
4. Henry Beers, "A History of the U.S. Topographical Engineers, 1813-1863," *The Military Engineer*, XXXIV (1942), 288.
5. Wood, pp. 38-57.
6. Stephen H. Long, *Voyage in a Six-Oared Skiff to the Falls of Saint Anthony in 1817* ("Collections of the Historical Society of Minnesota"; Philadelphia: Henry B. Ashmead, 1860), p. 75.
7. General Survey Act of 30 April 1824. 4 stat. 22.
8. *Ibid.*, p. 23.
9. U.S. War Department, *Explorations and Surveys for a Railroad Route from the Mississippi River to the Pacific Ocean* (no pub., 1858), p. 25.
10. U.S., Congress, House, *Message from the President of the United States, Transmitting Copies of Surveys Made in Pursuance of Acts of Congress, of 30th April, 1824, and 2d March, 1829*, Executive Doc. 7, 21st Congress, 1st Session, 1829, p. 17.
11. *Ibid.*, p. 20.
12. Florence Dorsey, *Master of the Mississippi, Henry Shreve and the Conquest of the Mississippi* (Boston: Houghton, Mifflin Co., 1941), p. 189.
13. *Ibid.*
14. Douglas Freeman, *R. E. Lee, a Biography*, Vol. I (New York: Scribner's, 1935), p. 137.
15. Robert E. Lee, quoted in Freeman, p. 141.
16. *Ibid.*, p. 154.
17. *Ibid.*, p. 143.
18. A. L. Long, *Memoirs of Robert E. Lee* (New York: J. M. Stoddart and Co., 1886), pp. 41-43.
19. Lee, as quoted in Freeman, p. 144.
20. U.S., Congress, Senate, *Report from the Secretary of War, in Compliance with a Resolution of the Senate of the 25th Instant, in Relation to the Rock River and Des Moines Rapids of the Mississippi River*, Senate Document 139, 25th Congress, 2d Session, p. 6.
21. Lee, as quoted in Long, p. 45. General Brooke, whom Lee met here was apparently not a West Point graduate, but Dick Tilghman was a graduate of the class the year before Lee's. He had resigned from the Corps of Engineers and at the time Lee met him at Galena he was a civil engineer on projects throughout the Upper Midwest.
22. U.S., Congress, House, *Letter from the Secretary of War, Transmitting the Inspection of Colonel S. H. Long, and the Report of Lieutenant Warren of his Operations During the Past Year on the Des Moines and Rock River Rapids, in the Mississippi River.* Executive Doc. 104, 33d Congress, 1st Session, 1854, p. 71.
23. U.S., Congress, Senate, *Report from the Secretary of War, Transmitting, in Compliance with a Resolution of the Senate Copies of Reports, Plans, and Estimates, for the Improvement of the Neenah, Wiskinsin, and Rock Rivers; the Improvement of the Haven of Rock River; and the Construction of a Pier at the Northern Extremity of Winnebago Lake.* March 25, 1840. Survey of Rock River, by Thomas Jefferson Cram, Captain, Topographical Engineers. Senate Doc. 318, 26th Congress, 1st Session.

24. John C. Fremont, *The Expeditions of John Charles Fremont*, Vol. I, Ed. Donald Jackson and Mary Lee Spenser (Urbana: University of Illinois Press, 1970), p. 115.
25. Joshua Barney was a graduate of West Point in 1820. He was commissioned in the Corps of Engineers but resigned in 1832. He worked as a civil engineer in service to the United States from 1844 to 1854. The title United States Agent was apparently given to civilians who supervised projects for which a set amount of money had been appropriated. They supervised such projects until the money ran out.
26. U. S., Congress, House, *Letter from the Secretary of War, Transmitting the Inspection Report of Col. S. H. Long, and the Report of Lieutenant Warren of his Operations During the Past Year on the Des Moines and Rock River Rapids*. Executive Doc. 104, 33d Congress, 1st Session, 1854, p. 56.
27. *Ibid.*
28. *Letter from the Secretary of War, Transmitting the Inspection of Colonel S. H. Long*, p. 14.
29. U.S., Congress, Senate, *Report of the Secretary of War in Answer to a Resolution of the Senate Relative to the Improvement of the Des Moines and Rock River Rapids*. Report by John G. Floyd, United States Agent. Executive Doc. 12, 33d Congress, 2d Session, 1854, p. 3.
30. *Ibid.*
31. Davenport *Gazette*, June 9, 1853, p. 2.
32. U.S., Congress, Senate, *Report of the Secretary of War, Communicating, in Compliance with a Resolution of the Senate of December 26, 1856, Information Relative to the Des Moines and Rock River Rapids, and the Harbor at Dubuque, Iowa*, Executive Doc. 45, 34th Congress, 3d Session, 1857, p. 32.
33. *Ibid.*, p. 4.
34. *Ibid.*, p. 32.
35. U.S., Congress, House, *Letter from the Secretary of War, Transmitting a Report Furnishing Information in Relation to the Improvement of the Des Moines Rapids, Report of John G. Floyd*, Executive Doc. 83, 35th Congress, 1st Session, 1858, p. 2.


CHAPTER III

# THE BEGINNINGS OF PERMANENT IMPROVEMENT

By the end of the Civil War Constitutional questions regarding the Federal role in public works were resolved for good. The Democrats in control of Congress from 1840 to 1860 had been suspicious of internal improvements and reluctant to make appropriations. But the Republican Party began its career with a declaration in favor of such expenditures. Their Platform of 1856 resolved that

> appropriations by Congress for the improvement of rivers and harbors of a national character, required for the accommodation and security of our existing commerce, are authorized by the Constitution, and justified by the obligation of the government to protect the lives and property of its citizens.[1]

The War had driven home the importance of internal improvements. The Mississippi River, especially, could be used to reunite the North and the South.

Further impetus for the improvement of the Upper Mississippi came from the low water of 1864 when the River reached the lowest point ever recorded.[2] Navigation was almost wholly suspended as even the lightest boats were unable to reach St. Paul. The low water of 1864 became the mark against which all future improvement works were measured.

In addition, while traffic on the Lower Mississippi had reached its peak in the 1840's and 1850's, and had already begun to decline, the Upper River was experiencing a growth of river traffic that would not peak until the 1880's. Dissatisfied with the poor response of their representatives in Congress, cities along the Upper Mississippi began holding river improvement conventions to push for Federal money. By 1860 these conventions had become almost routine.[3] Two major conventions during the winter of 1865-66 attracted particular attention.

On December 15, 1865, the St. Louis Merchant's Association convened a Committee on Improvement of the Mississippi River and Tributaries. The concerns of this meeting were the rapids on the Upper Mississippi and the coming problem of bridges. Statistics assembled for the meeting showed that of the 910 registered vessels on Western waters (including the Ohio) in 1865, 20 listed their home port as Galena, 20 as Dubuque, 15 as Keokuk, and 39 as St. Paul. The Committee noted that in 1865 the loss of river commerce by detention and accident at the Des Moines Rapids alone was $500,000. Boats often took three to five days to navigate the eight miles of shoal water along the length of the rapids.

The Convention also remarked on the increase in tonnage made possible by the use of

barges. In 1865 the towboat *Ajax* had taken a tow of 15 barges with 300,000 bushels of coal (11,400 tons) down river with a crew of 25. Finally, the Committee, concerned about the number of proposed bridges across the river, recommended that the drawbridges at Rock Island and Clinton be removed as obstructions to navigation and replaced by high bridges with a span 50 feet above high water, and that all future bridges be of similar design.

On February 14-15 a larger and more varied convention was held at Dubuque with rivermen, businessmen, Senators and Representatives in attendance. The purpose of this convention was to seek an immediate appropriation from Congress large enough to overcome the obstructions to navigation caused by the Des Moines and Rock Island Rapids.

The opening remarks at the convention echoed the sentiments of many people in the Valley: "Now that 'the clangor of arms has passed away,' we may turn to the peaceful pursuits of life—to the development of these vast resources that spread around us."[4]

The convention was quick to point out that farmers and merchants in the Midwest were at a disadvantage compared with the East, since prices for grain and commodities were determined in New York. The price of grain around the country was the price at New York minus the cost of shipping it there. The price of wheat on February 2, 1866, was $1.77 per bushel in New York, $1.21 at Chicago, and $1.00 at Dubuque. An Eastern farmer who could get his grain to market for little or nothing was more than 70¢ per bushel ahead of the farmer in Dubuque, who had to ship by rail. In this kind of market even the ten or fifteen cents per bushel that improving the rapids would save could improve the economy. In fact with the rapids improved, one member of the convention believed that a bushel of Dubuque wheat could be shipped to Liverpool, England, and sold for fifty cents per bushel less than its present price there.

The convention brought up another argument frequently used thereafter by both Engineers and rivermen: that improving navigation would lower rail rates, bringing extra benefits. There was some truth to that. The Illinois Central charged the same rate to ship a bushel of wheat from East Dubuque to Chicago as it did to ship the same wheat to St. Louis (more than twice the distance), where the railroad had to compete with the Mississippi traffic.

The Dubuque convention again raised the issue of how best to improve the Des Moines Rapids. Major Floyd who had supervised work on the Rapids in the mid-1850's and who now lived at Keokuk, spoke in opposition to a lateral canal, as did many other critics. They pointed out that any significant increase in river traffic would make a lateral canal with locks a bottleneck, leaving the River as incapable of handling the growing commerce of the Valley as the railroads presently were.

In the end, however, the convention passed a series of resolutions that were similar to those of nearly every other river convention on the Upper Mississippi. The convention resolved that Federal money should be used for improvement of the Rapids, that whatever the resulting improvement was it should be toll-free, and "that the mode of improvement should be left to competent engineers of the Government."[5]

In a very real way, even the railroads, traditional enemies of the steamboat interests, helped to bring about river improvement. Before the coming of the railroads steamboatmen were content to limit improvements to the removal of snags and other dangerous obstructions. With no competition they could charge high rates with little complaint from merchants. The arrival of the railroads meant that much more significant river improvements had to be undertaken for the steamboat to remain competitive.

Under the prodding of all these pressures, Congress moved toward much larger projects than ever before. They were assisted and sustained in this by a growing surplus in the United States Treasury. The beginning of permanent navigation improvement on the Upper Mississippi can be traced to the Act of June 23, 1866, which made appropriations for the repair, preservation, and completion of certain public works, and for surveys of the Upper Mississippi and its tributaries. With the understanding that a 4-foot channel was to be an eventual goal, Congress appropriated $200,000 for the Des Moines Rapids, $100,000 for the Rock Island Rapids, and $100,000 for other channel improvements and surveys north of St. Louis. These amounts were recommended by a Board of Engineers convened on March 1, 1866, and were identical with those suggested by a previous Board of Engineers which had met in 1854.

To carry out the improvements authorized by this Act, Chief of Engineers A.A. Humphreys appointed three Engineer officers to different posts. On July 31, 1866, he assigned Major G.K. Warren to duty at St. Paul. Major Warren was to examine the Upper Mississippi River above the

Rock Island Rapids as well as its tributaries (specifically the St. Croix, Minnesota, Cannon, Chippewa, Zumbro, and Wisconsin Rivers), to examine "material necessary to determine the best manner of bridging the Mississippi from St. Paul to St. Louis, so as to occasion least obstruction to navigation,"[6] and to determine the best means of securing a 4-foot channel from St. Louis to the Falls of St. Anthony. Lt. Col. J.N. Macomb was made Superintendent of Western Rivers Improvement outside the Ohio, with offices in Cincinnati. This post put Colonel Macomb in charge of more than 7,000 miles of waterway. His primary duty was the design, construction and supervision of snagboats. He designed and built two double-hulled snagboats along lines of Shreve's earlier boats. Although these were primarily for the Lower Mississippi, Colonel Macomb did make several trips to the Upper River to assist Major Warren. On August 3, 1866, General Humphreys ordered Lt. Col. J.H. Wilson to take station at Keokuk, Iowa, to superintend the improvement of the Des Moines and Rock Island Rapids, and to make a survey of the Rock River. On August 14, 1866, Humphreys further ordered Colonel Wilson to a survey of the Illinois River from its mouth to La Salle.

Major Warren carried out his survey duties during August and September. He placed assistants in charge of examining the several tributaries and took charge of the survey of the Mississippi himself. Warren examined the whole length of the River above Rock Island both from shore and by packet, making careful surveys in 14 different places involving 74 miles of survey. He also considered several methods of dredging sandbars before deciding in favor of the Long Scraper previously developed by Major Long for work on the Lower Mississippi. The following year when Warren bought two large steamboats under his appropriation, he had them outfitted with the Long Scrapers.

Warren's orders of July 31 directed that he was to examine the Mississippi "with a view to ascertaining the most feasible means of economizing the water of the stream of insuring the passage of boats drawing four feet of water."[7] Major Warren assumed that the phrase "economizing the water" had been introduced into the Act of June 23 by Senator Ramsay of Minnesota who agreed with rivermen and lumber interests in believing that closing side chutes and otherwise narrowing the natural channel of the River was the best means of improving navigation.[8] Although Warren was suspicious of closing dams and wing dams as means of permanent improvement, he interpreted his orders strictly, and became the first Engineer to request funds for wing dams on the Upper Mississippi. He determined to build two experimental dams, a closing dam at Prescott Island and a wing dam near the foot of Lake Pepin.

Meanwhile, Colonel Wilson went to Washington after receiving his orders of August 3 to confer with Chief Engineer Humphreys and to familiarize himself with previous surveys and reports on the Upper Mississippi. He also requested and received orders permitting him to travel back and forth to the various projects under his charge without prior individual permission.

Colonel Wilson left Washington for Keokuk sometime after August 14, using this last order to visit Chicago for supplies. He then proceeded to Rock Island where he had requested those assistants who were to undertake the surveys of the Rock and Illinois Rivers to meet him on August 20.[9] During several days in Rock Island he arranged survey parties for both rivers.[10] He sent Capt. P.C. Hains ahead of him to Keokuk and arrived himself a day later, on August 25. He and Captain Hains took quarters at the Deming House in Keokuk.[11]

He had already made arrangements with a civil engineer, James Worrall, to undertake the Rock River survey beginning September 1. The Illinois River survey (for which he may have made arrangements in Chicago), was scheduled to begin September 10. Because the previous surveys and maps of the two Rapids were not complete enough for the extent of improvement now contemplated, Wilson ordered Captain Hains to Davenport, Iowa, to open an Engineer Office and to begin a survey of the Rock Island Rapids. Civil engineers H.A. Ulffers and E.F. Hoffmann were placed in charge of the resurvey of the Des Moines Rapids. All of these surveys were completed during the fall of 1866.

Colonel Wilson did not remain long in Keokuk. Having gotten all of the surveys well under way, he wrote a letter to General Humphreys on October 1: "I have the honor to request that I may be directed to take post permanently at Davenport or Rock Island, instead of Keokuk, as either of those points is much more accessible, affords better means of communicating with the works under my charge, and greater advantages in the way of personal accommodations to myself and assistants."[12] By October 25 Wilson had receiv-

FIG. 6. The first permanent Engineer office in Keokuk, Iowa, opened in 1866 or 1868. This photo dates from about 1875.

FIG. 7 The first District Office in Rock Island opened in 1869 on the second floor above this wine and tobacco shop (the building with the awning) on the corner of 19th Street and Second Avenue. The office was across from Spenser Square and the famous Harper House.

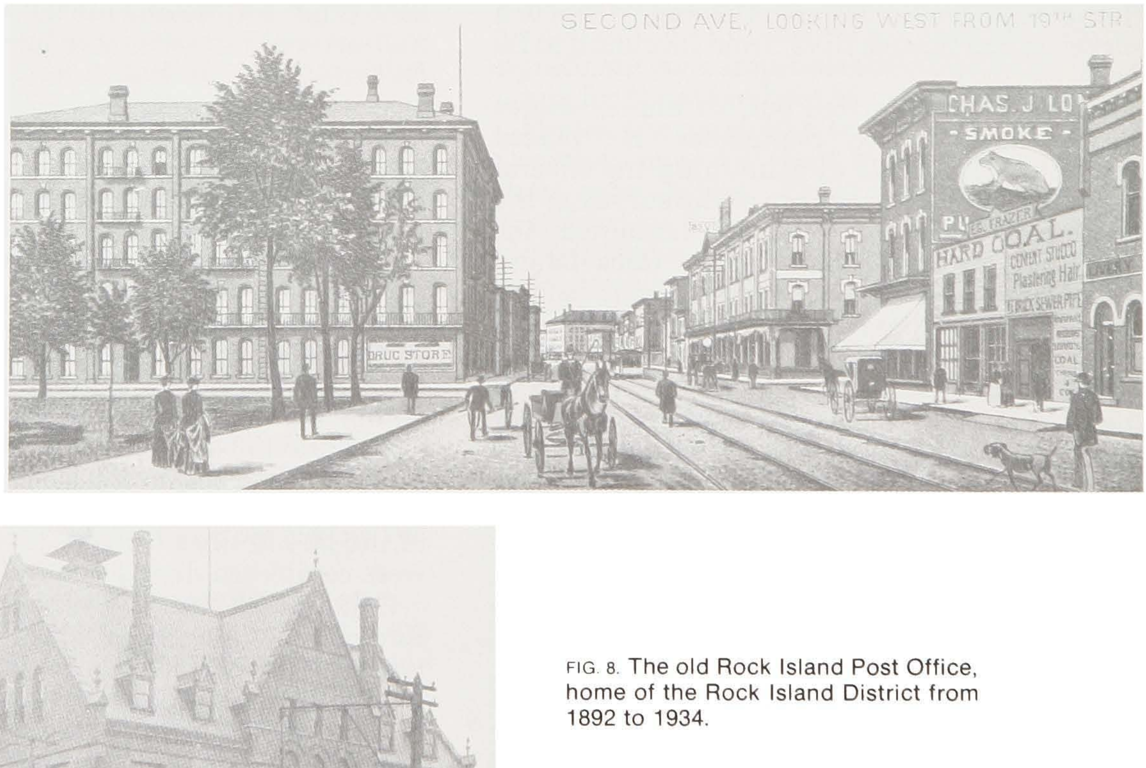



FIG. 8. The old Rock Island Post Office, home of the Rock Island District from 1892 to 1934.

ed orders changing his post to Davenport, and by the first or second week of November he had moved, leaving Mr. D.C. Jenne, a United States Civil Engineer, in local charge at Keokuk.

Early District records suggest that Colonel Wilson established a U.S. Engineer's Office in Keokuk in a two-story frame building at Main Street and Blondeau, two blocks above the Mississippi River. He may have set that office up before leaving for Davenport, but more likely, he established it in the spring of 1868 when he returned to a post at Keokuk to take direct supervision of the complicated Des Moines Rapids Canal.

The Davenport Office to which Colonel Wilson moved had already been set up early in September by Captain Peter Hains on the second floor of a building at Second Avenue and Main Street.[13]

## SURVEYS OF THE ILLINOIS AND ROCK RIVERS

Colonel Wilson completed a survey of the portion of the Illinois River assigned to him during the fall of 1866, but he decided that before any plan of improvement could be suggested it would be necessary to extend the survey all the way to Lake Michigan. Early in 1867 William Gooding, who had been Chief Engineer on the Illinois and Michigan Canal, was assigned to assist with this expanded survey, authorized by the Act of March 2, 1867. An appropriation of $20,000 for this survey was made by Congress on May 8, and on May 13 Wilson received orders to organize a Board of Engineers, consisting of Gooding and himself, to conduct a survey and examination and prepare plans and estimates for "a system of navigation by the way of the Illinois River, between the Mississippi and Lake Michigan, adapted to military, naval, and commercial purposes, in accordance with the act of March 2, 1867."[14]

The State of Illinois for a long time had been agitating the Federal government to expand the Illinois and Michigan Canal and improve the Illinois River. Colonel Wilson recommended that money be appropriated so that this work could begin in the spring of 1868.

The survey of the Rock River which Colonel Wilson was ordered to make represented a continuation of the canal craze that had captured the East in the 1830's. As early as Major Long's explorations of 1823 there had been suggestions that connecting the Mississippi with the Great Lakes and the Eastern markets would be desirable. The completion of the Illinois and Michigan Canal by the State of Illinois in 1848 had helped Chicago to boom.

Wilson's order concerning the Rock River directed him to make a survey and collect information "sufficient for a project by the Rock River route with all its details, adapted to the construction of Locks, Dams, feeders, and reservoirs, for a waterway, admitting the largest boats now navigating the Western and Eastern waters that form the entrance to such a Canal route."[15]

Under Wilson's direction, James Worrall began this survey on September 1 at Fond du Lac, Wisconsin, and finished on December 1 at Rock Island. Worrall and his party had access to the latest survey instruments, but they also "made do" at times with materials at hand. In order to measure the surface velocity of the river, Worrall used white apples which could readily be seen passing section lines along the shore.[16]

In his report Worrall pointed to the commercial need for such a route to the Great Lakes. The rising lumber industry was already producing 4,000,000 feet of lumber annually in Wisconsin and Michigan—more than all the new rail routes existing or being planned could handle. Iron ore from Lake Superior also needed cheap shipping to new markets.

The canal route mapped out by Worrall ran from Green Bay on Lake Michigan to Rock Island. A small canal already connected Green Bay with Lake Winnebago, but the remaining 285 miles of the route surveyed by Worrall all needed improvement. Using Lake Horicon as a summit reservoir, Worrall planned a system that involved the construction of 117½ miles of canal with the remaining distance running through slack water sections of the Rock River. The plan involved 56 lift and 9 guard locks. Worrall actually drew up three separate plans involving locks ranging in size up to 200 by 30 feet, large enough for the stern wheelers, but not enough for the "largest boats" called for by the Act of June 23, 1866.

Worrall was not concerned by the size and length of canal he had planned. In a letter written to Colonel Wilson from the field, Worrall reported that a long canal was not an objection "in a country like this where all the appliances for making a canal have been left by nature at the engineers' disposal."[17]

In his report Worrall imagined a day when ore from Lake Superior would combine with

limestone and coal from the lower Rock River, and there would arise "Birminghams, Pittsburghs, along the Rock River."[18] That was just a beginning:

It is impossible to foretell statistics of this country. Attempt a prediction, and it will be ridiculed as preposterously large. Let a decade of years pass over the heads of the population, and reality will have so far outstripped the highest-colored, most visionary anticipation.[19]

Eventually, wrote Worrall, the cities of the Rock River: Fond du Lac, Beloit, Rockford, Sterling, Dixon, "all to be Buffalos, Rochesters, Uticas, in a shorter time than it took to develop the cities on the Erie Canal."[20]

Colonel Wilson's section of the Rock River Report was much more conservative. He pointed out the limitations of the summit reservoir and the tremendous expense, estimated at nearly $15,000,000, for the project. This report was submitted to Congress on April 11, 1867, but no action was taken.

## IMPROVING THE RAPIDS

While the surveys of the Rock and Illinois Rivers were being carried out by his assistants, Colonel Wilson was busy examining the results of the resurveys of the two rapids made by his staff. By January 1, 1867, he was ready to report his recommendations for improvement. For the Rock Island Rapids Wilson determined to follow the plan generally recommended by Buford, Lee, Shreve, and Warren to excavate and straighten the existing channel.

At the Des Moines Rapids, however, he departed from the recommendations of most previous Engineers and determined to construct a lateral canal along the Iowa shore, a modification of the plan suggested in 1836 by Henry Shreve.

In order to understand the different problems presented by the two Rapids, it is important to note how structurally varied they were. The Upper Mississippi River was formed during the four glacial ages of the Pleistocene epoch, and is not old as geological history goes.

Prior to the first of the ice sheets the river flowed down through central Iowa to just south of Muscatine, then curved west around the present Des Moines Rapids. Then the Nebraskan Glacier pushed the channel over to its present location down to Clinton, Iowa. Here the edge of the ice sheet forced the river to run over hard rock rather than seek its natural valleys. The river over a long period of time scoured down through this rock creating the deep valley hemmed in by bluffs that exist today. From Clinton south the river went west, around both the Rock Island and Des Moines Rapids.

Then the Kansan glacial age arrived, several hundred thousand years ago, and pushed the channel of the river east from Clinton until it met the Illinois River at Hennepin; from here it flowed with the Illinois to near St. Louis. As this glacier retreated it left a large flat plain in central Iowa in which valleys formed for the Cedar, Iowa, and Skunk Rivers. These three rivers joined just above Keokuk and crossed the Des Moines Rapids. From here they flowed south to join the Mississippi River where the mouth of the Illinois is now.

During the third glacial age, the Illinois Glacier moved the Mississippi toward the west. It blocked the Cedar and Iowa Rivers and formed Lake Calvin covering much of central Iowa. Lake Calvin drained south over the Des Moines Rapids.

Finally, about 20,000 years ago, the Iowa and Tazewell Glaciers came together near Clinton during the Wisconsin Age and forced the Mississippi over the Rock Island Rapids. By the time these glaciers had retreated, the river had adopted nearly its present channel.

The last glacial sheet, the Mankato, arrived about 12,000 years ago and deposited huge amounts of gravel, silt, and sand near St. Paul. This eventually filled in the riverbed as far as St. Louis. Erosion of this gravel bed left the valley with its characteristic terraces at the 25 and 75-foot levels. Colonel Wilson noticed these terraces. He pointed out that the town of Nauvoo was built on the 25-foot terrace while Sandusky was on the 75-foot level.

The Des Moines Rapids, then, is older by thousands of years than the Rock Island Rapids, while the sandbars that caused so much trouble to navigation and so many problems for the Engineers are comparatively recent.

Colonel Wilson brought with him to his work a thorough understanding of geology. The glacial theory was too recent in 1866 for him to have come across, but his examinations of the geological features above the Des Moines Rapids made him conclude that the Rapids had once been the outlet of a huge Iowa lake.[21]

The Rock Island Rapids consists of seven chains of rock projecting out into the channel from both the Illinois and Iowa shores. These begin with Lower Chain near the foot of Rock Island and are scattered for 14½ miles upstream to Upper or Smith's Chain near Le Claire, Iowa. Not all of the chains reach all the way across the

channel. Between chains pilots could generally find deep water even during the low water season. The real problem on the Rock Island Rapids was not shoal water, but the narrow, tortuous channel that passed near one shore or the other, back and forth several times in the course of the rapids, forcing boats to the danger of moving sideways against the swift rapids current. Of the 14 miles of rapids, 11 miles were good water. Only 3 miles were difficult or dangerous. The problem was knowing where those three miles were.

Because a pilot who knew the Rapids by heart could get a boat through even in low water, a thriving business in rapids pilots grew up in Le Claire at the head of the Rapids. Captains would find these pilots gathered at the Green Tree, a famous Le Claire landmark used as a guide by river pilots, and hire them to steer their boats through the channel.

The rapids at Keokuk were completely different. Here the river in wearing a channel had come across an 11-mile long strip of rock much harder than the rock above and below it. This was a layer of cherty limestone of the Keokuk series inclined at the same slope as the river in this stretch. Rather than being constructed as a typical rapids, the Des Moines Rapids ran over a relatively smooth rock bed which behaved exactly like an artificial dam with deep water behind it. In several places through the 11 miles of rapids the water had worn indentations and holes, but they were not connected. During low water these rapids were almost impossible to cross. The shoal stretches of the Rapids were called chains, but there were no real chains of the kind found at the Rock Island Rapids. The water surface showed none of the traditional ripples common to other rapids, making it difficult for pilots to know where deeper water was.

Thse two obstacles to navigation provided the Rock Island District with its first real test of the Engineers' ability to adapt, to experiment, and to solve unique problems.

## THE ROCK ISLAND RAPIDS

In making assignments in September of 1866, Colonel Wilson ordered Capt. P. C. Hains to Davenport to supervise the Rock Island Rapids Improvement. He was instructed to make a detailed survey of places on the Rapids where boats experiences shoal water, swift currents, or twisting channels, and from this to make an estimate of the excavation necessary to make navigation safe. He was also to locate the Rock Island Bridge on his maps, ascertain the direction of currents through the bridge and assess the general influence of the bridge on navigation. Finally, he was to find out how much underwater rock excavation might cost using different methods.

Captain Hains completed his field work in September and convened a Board of Engineers at the Davenport Office on December 19 to consider alternate methods of improvement. In addition to Hains the Board included three civil engineers: D. C. Jenne, in local charge of the Des Moines Rapids, and James Worrall and W. F. Shunk, who had made the Rock River survey.

The Board considered three possibilities. Overcoming the Rapids by locks and dams (three would be needed) was rejected because of a principle adopted early in the work that "no plan should be adopted for the improvement of navigation in low water that would be prejudicial to its present state in high water."[22] The second possibility was a lateral canal which would leave the main channel open for use in high water. But the Board chose the third possibility, improvement of the natural channel, as the best solution. A lateral canal would be expensive and would not be useful until the whole was done, while each improvement of the natural channel would show immediate results. In addition, a lateral canal would need an annual appropriation for operation and maintenance.

One possibly serious objection was raised to widening and deepening the natural channel. The chains of the Rapids acted as a series of dams which held the water back in the pools behind the chains. Some rivermen argued that opening the natural channel would let the water through faster, lowering the level of water along the entire rapids and making them an even worse obstruction. The Board had made careful calculations and were convinced that this would not happen, but it was a recurring argument that Major G.K. Warren had to answer as early as 1854.[23]

The Board recommended that the present steamboat channel be enlarged to 200 feet wide by 4 feet deep, that the excavated material be deposited in the river bed so as to check cross currents and confine water to the main channel, and that wherever possible, excavation take place by the use of coffer dams. The cost of the improvement was estimated at just over $800,-000.

In the spring of 1867 Colonel Wilson decided

that the Hains survey was not yet of sufficient detail to begin work and assigned Lt. E. F. Hoffmann to make a survey. Lieutenant Hoffmann began work at the end of May and completed sounding in August. Hoffmann was one of many employees of the Rock Island District who gave long years of devoted service to Upper Mississippi River improvement. He remained with the District as a civil engineer after resigning from the Army, and from 1870 until his death in 1884, served as engineer in local charge of improving the Rock Island Rapids. At the time of his death the project was virtually complete.

A contract for rock excavation was made with Case and Co. of Fulton, New York, in June of 1867. The first work began on the Duck Creek Chain that fall under the supervision of District engineers. Between September 8 and October 15 a coffer dam was built around the area to be excavated. Water was pumped out and the work of quarrying began on October 22 and continued until December 20, with an average force of 128 men per day.

With their work on the Rock Island Rapids, Engineers of the Rock Island District developed a procedure they were to use in succeeding river projects. Rather than begin at one end of the Rapids and work methodically to the other, cutting the channel to its required dimensions, they began with the worst obstruction, then moved on to the second-worst, and so on. This little-here-little there policy must have looked terribly uncoordinated and unplanned to an outside observer, and it did not show immediate and dramatic results, but it was appreciated by river captains and pilots.

Three methods were used to excavate rock on the Rock Island Rapids. The most frequent was by coffer dam and subsequent quarrying of rock. Coffer dams were typically used where the river was shallow, from 6 to 14 feet, though a coffer dam at one point on Sycamore Chain reached 25 feet. Prior to work on the Rock Island Rapids, engineers in both Europe and America had fastened such dams in place with iron rods sunk 15 inches into the rock bed. These 2-inch rods were placed in parallel rows 10 feet apart. Contractors and Engineers at Rock Island believed that a coffer dam would remain in place of its own weight. They proved to be right, effecting a significant saving of effort and material.

Coffer dams were constructed by forming a breaker ahead of the dam, then putting the dam down. The dam itself consisted of two parallel timber walls running from 10 feet apart at the head of the dam to 8 feet along the sides. The walls were braced and held together with flat iron tie rods secured by washers and pins; then they were filled with a mixture of clay and gravel (puddling) pumped from the river bed. Following this the water was pumped out of the work area.

The smallest of these coffer dams enclosed an area of 2.26 acres on Upper Chain; the largest, at Campbell's Chain, enclosed 43.07 acres using 5,780 feet of dam.

Quarrying the rock was done mostly with hand drills and blasting powder. Steam drilling was tried during 1868-69, but did not work out well. Drill bits varied from 1½ to 2½ inches. Holes were drilled from 1½ to 4 feet deep. Then the water was sponged out, the holes filled with clay and drilled again, making a water-tight hole. One pound of powder was used for each 7/13 cubic yards of rock. The broken rock was then taken to the shore, or carried up inclines built to the top of the dam, where it was transferred to flatboats and dumped outside the channel.

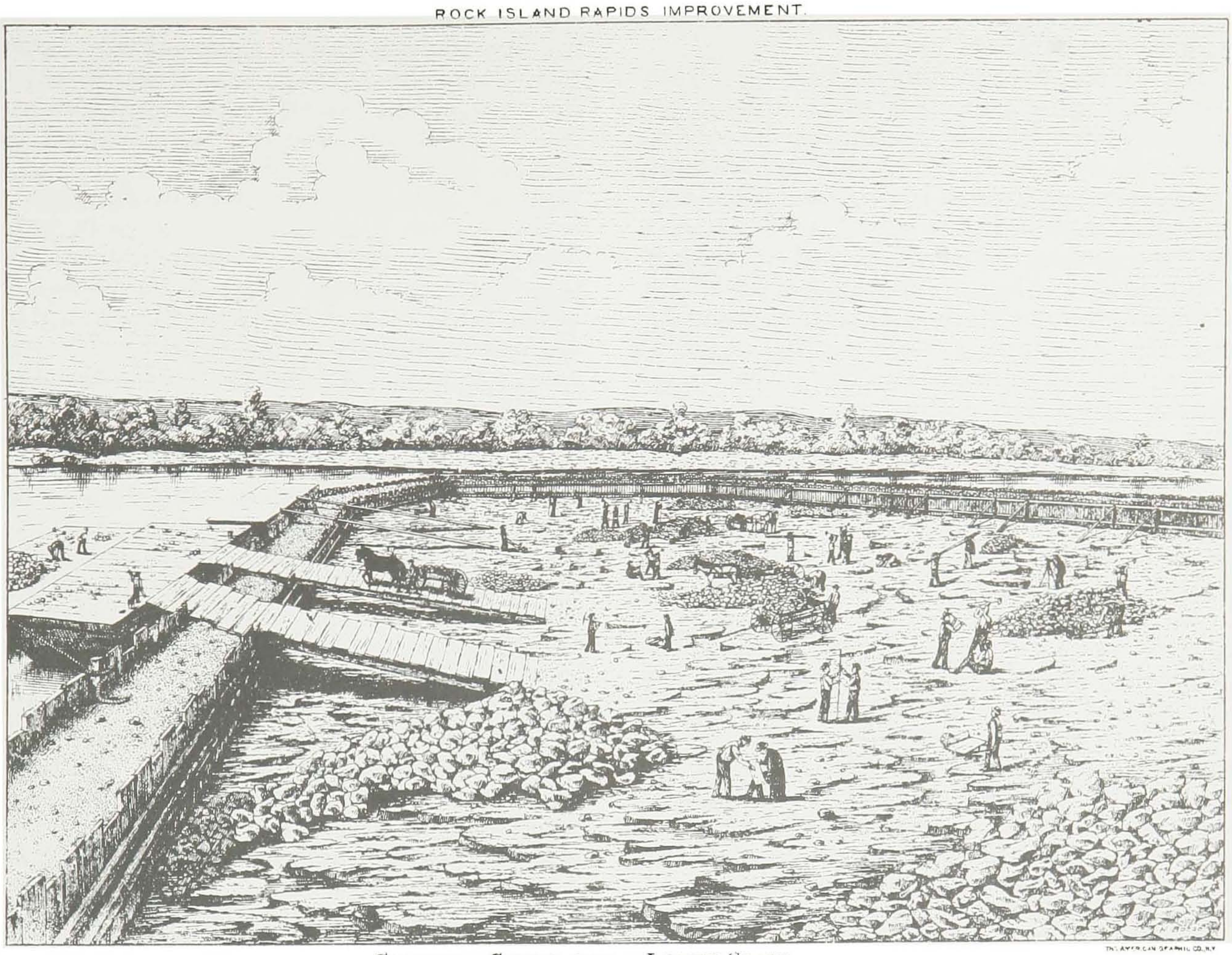
Coffer dams generally worked well, but they were subject to two hazards. Passing steamboats were not alway as careful as they should have been in their attempts to make time (and therefore money). In the treacherous currents of the Rapids they frequently ended up colliding with the dams and delaying the work. Second, the Mississippi was subject to sudden spells of high water, causing several dams (which were built no higher than absolutely necessary) to flood.

Where coffer dams were not practical because of a deep or very uneven bottom, or where the area to be enclosed was too small, rock was removed by chisel boat and dredge using equipment similar to that developed by Major Floyd in 1853. The chisel was a 12 inch square beam 12 feet long suspended between iron rails over the downstream end of the chisel boat. The beam was headed by a conical shoe of wrought iron with a steel point welded to it. Until 1872 when a Mr. A.J. Whitney invented exchangeable points, the whole 3½ ton chisel had to be shipped by rail to a Chicago shop for its frequent sharpenings.

In addition to the slowness of operation, chisel dredging invariably missed spots, and very careful work was necessary to clean up all the broken rock.

Coffer dam excavation and chisel dredging were supplemented by a small amount of sub-

ROCK ISLAND RAPIDS IMPROVEMENT.



SKETCH OF COFFER-DAM AT LOWER CHAIN.

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FIG. 9. A coffer dam and rock excavation on the Rock Island Rapids. This sketch was drawn by Henry Bosse, a draughtsman at the District Ofice during the 1880's.

marine blasting, never as successful as other methods, carried on between 1875 and 1880 at St. Louis and Moline Chains. Blasting was accomplished by timber tripods erected to rest on the river bottom. A narrow platform was built around the outside of the tripod at the water level. Here two men operated the drilling equipment and stuffed holes with blasting powder. When a large area was to be blasted, a chain of tripods was erected and connected by catwalks. The broken rock was removed by ring bolts split at the straight end, with a wedge inserted in the split. The bolt was driven into cracks in large pieces of broken rock, where it wedged tight. The rock was then lifted out onto flatboats by the use of boom dredges.

One particularly large rock in the channel near Campbell's Island succumbed to Corps' ingenuity in an especially interesting manner. This rock, sometimes above water and sometimes below, depending on the water level, was a constant hazard to navigation. It was on this rock that Lieutenant John Campbell and his men became grounded in July of 1814 while fighting Indians in the westernmost battle of the War of 1812. The Indians, allies of the British, attacked the helpless boat, killing 16 men and wounding 21—including Lt. Campbell who lay near death for several months.

The rock was finally destroyed by engineers in 1870. While it was exposed during a period of low water, cordwood was piled on its surface and set afire. When the flames died down a crowd of men with buckets threw cold water on the extremely hot rock, causing it to split and

break into pieces. Explosives were placed in fissures that remained and the rest of the obstruction was blown apart.[24]

Work on the 4-foot channel through the Rock Island Rapids continued until the 6-foot channel project in 1907 made it necessary to redo the whole plan. In 1851 a veteran riverman had appeared at a river improvement convention at Burlington, Iowa, and offered to undertake to improve the Rock Island Rapids to accommodate the largest boats for $20,000 "for the simple reason that he could make money by doing it."[25] That proved to be a rather low bid. By 1886 when the project was finished with the exception of several small isolated patches, the Corps of Engineers has supervised the removal of 87,926 cubic yards of rock at a net cost of $1,166,608.[26] The final cost of the project by 1907 was $1,508,458.

## THE DES MOINES RAPIDS

The Des Moines Rapids had long been a more annoying obstruction to navigation than the Rock Island Rapids. Many groups had made attempts to improve them before Colonel Wilson arrived as superintendent in 1866. From 1829 to 1866 the Corps of Engineers had spent $335,000 on the Rapids. However, only about 25,000 cubic yards of rock had been removed. More of the money had been spent on experiments and preparations for the many different plans than in actual improvement.

Private groups also developed many different plans for getting around the Rapids. In 1837 a charter was granted to a private company for the Des Moines Rapids Railroad which was to run along the Illinois side from Warsaw to Commerce. The promoters felt that this would be the most valuable rail line in the United States, carrying steamboat cargo around the Rapids.[27] The company ran into financial difficulty before the road could be built, but the Mormons at Nauvoo intended to carry the project out until their leader, Joseph Smith, was killed in 1844. A railroad at this time might have been a success. Nearly 300,000 tons of merchandise were carried around the Des Moines Rapids in 1837.[28]

Private individuals and groups made several attempts to build dams at the Rapids for both power and navigation. A wing dam of earth covered by stone was built at the head of the Rapids in 1841. Water from this dam powered a grist mill for two seasons before the dam washed away. A similar attempt at Nauvoo in 1842 met the same fate. When Joseph Smith was killed the Mormons had been planning a project that may have been successful. Smith planned to construct a large dam stretching nearly all the way across the River to Montrose, leaving only a small channel open. The dam was to have provided power, and the closure of the channel was to have backed up the river, giving Nauvoo a deep harbor.

But navigation over the rapids had not been significantly improved by 1866. During low water steamboats still had to transfer their

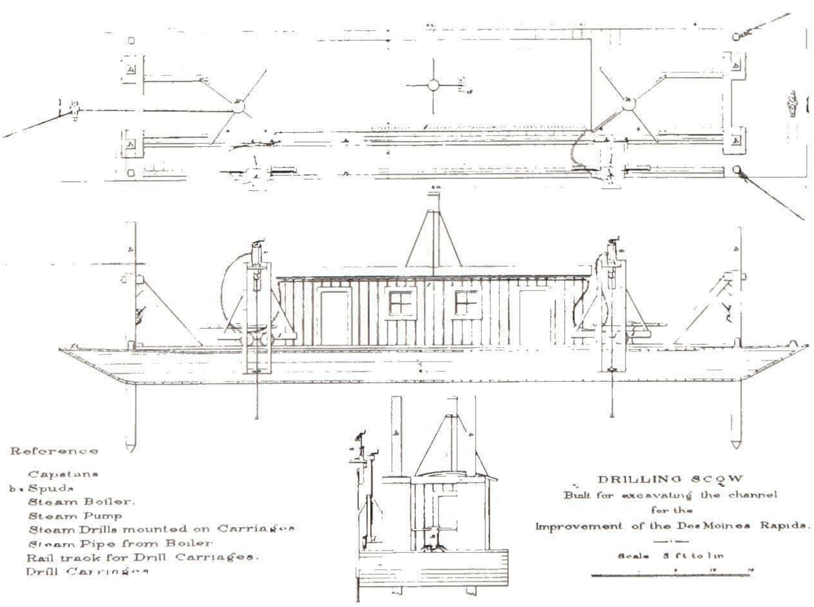



FIG. 10. Plan for a drilling scow built for the Des Moines Rapids Canal project.

cargo to lighters or to the railroad between Keokuk and Montrose which began hauling freight in 1856. Passengers, too, had to make this transfer, going by rail or stagecoach.

The business of lightering was an old one. Father Francis Xavier who travelled the area in 1721 wrote about the rapids where passengers were obliged to unload and carry their pirogues.[29] When the French fur trade developed the Sac and Fox Indians set up villages near Nauvoo and Keokuk to serve as guides on the Rapids. When Lt. Zebulon Pike came up the Mississippi in a keelboat in 1805, he was met by a party of Sac lightermen who relieved his boat of 31 heavy barrels of supplies so that it could cross the Rapids.[30]

Later, the towns of Montrose and Keokuk arose to support the lightering trade. By 1850 there were two shipyards at Montrose specifically for the repair of lighters, which received hard usage. Lightering employees, called "ratters," developed what was perhaps the first union west of the Mississippi to protect their interest.

Lightering was costly to the steamboat industry. The cost of lightering freight was $1.00 per ton, in addition to the cost of labor to transfer the goods to and from the steamboat. In addition to the cost of freight, an average steamboat crossing the Rapids spent $500 per day in lost time and wages. Colonel Wilson estimated that the 90 days of low water during the 1866 season had cost boats passing the Rapids $250,000 in extra labor, plus $1.00 per ton for freight, a rate that meant the Des Moines Rapids was costing farmers, merchants, and steamboatmen of the Upper Mississippi Valley a half million dollars a year. During the 1867 season the Northern Line Packet Company alone paid $200,000 in lighterage fees.[31]

The need for rapids improvement was pressing. By 1866 the five states bordering the Mississippi above the Rapids were producing between one half and one third of the produce in the United States. 304 steamers with a total value of over ten million were serving the Upper Mississippi. In addition, the lumber industry was coming into its own. Over 400,000,000 feet of lumber were being rafted downriver annually. The Des Moines Rapids added 2% to the price of this lumber.

Colonel Wilson found previous maps of the Rapids of little help in determining the best method of improvement. Lee's map he found to be of no use except as a general picture, and Warren's map, though accurate, was limited to illustrating the project of excavating a natural channel. Wilson put civil engineer H.A. Ulffers in charge of a resurvey, assisted by E. F. Hoffmann. During this survey, which took the entire fall to complete, Ulffers and Hoffmann made between 40,000 and 50,000 soundings of the Rapids.

The Des Moines Rapids extended for 11¼ miles from just above Keokuk to just north of the village of Montrose, Iowa. Gentle waves in the continuous rock shelf which comprised the rapids were identified as chains. There were five of these on the Des Moines Rapids: Lower, English, Lamallee's, Spanish, and Upper.

Colonel Wilson investigated several methods of improving the Rapids. He rejected the earlier plans of Buford, Lee, and Warren to excavate the natural channel because the expense involved in cutting a channel through the whole 11½ miles of rock would be prohibitive, and because a narrow channel through the Rapids where the surface would not indicate its whereabouts would be impossible to use at night and in fog. Even during the day boats would be liable to be blown out of the channel onto the rapids.

Wilson rejected locks and dams for the same reason that they were rejected on the Rock Island Rapids: they would be a hindrance in high water. Several local groups made proposals to Wilson, but the only feasible one investigated came from "certain parties in Illinois."[32] This was to build dams of rock and brush in cribs across the river to within 500 or 600 feet of the Iowa shore. From here a rock and brush wall would be built parallel to the shore for a mile downstream. One of these was to be built for each of the chains. These constricted channels would act as sluiceways, shooting steamboats over the chains. This plan Wilson rejected because he felt the dams would not withstand the movement of ice in the spring.

Based on the evidence he had assembled, Colonel Wilson decided on a lateral canal as the best solution. This was the plan which Henry Shreve alone had recommended to the Corps of Engineers, but which rivermen had long favored. Editorials in the Keokuk *Gate City* before and after Wilson's arrival there show strong sentiment for a canal. Two days before Wilson's arrival one headline read: "Know you not, Oh! city reader, that Keokuk can be made the Lowell of this Western Country, if we but have a canal?"[33] A canal was endorsed by the Keokuk City Council two days after Wilson arrived, and on October 3, representatives of the Merchant's Exchange met with Wilson to push

for a canal.

One Keokuk resident, General Samuel R. Curtis, had been a canal advocate for a long time.[34] In 1848 he had developed rather complete plans for a canal to be constructed by building an embankment out into the river and excavating the space between the embankment and the shore. The Curtis plan called for one lock with a lift of 24 feet.[35] This plan was much closer to the one adopted by Wilson than was Shreve's plan for excavating a channel along the shore. Shreve had never recommended an actual canal with locks.

Colonel Wilson's report on the Des Moines Rapids recommended that a navigation canal be built along the Iowa shore from Keokuk to Nashville, a distance of 7.6 miles. From Nashville to the Upper Chain boats would use the natural channel, which was deep enough without improvement. At the Upper Chain Wilson proposed to cut a channel 200 feet wide, 6 feet deep, and 2,400 feet long. The canal itself would have a 300-foot by 6-foot channel with three locks. The 6-foot depth recommended by Wilson was 2 feet more than called for by the Act of June 23, 1866, but he accurately predicted that within fifty years the low water depth of the Mississippi would be increased to six or seven feet.

Wilson decided on the canal as the best method of improvement because it would leave the natural channel free both during and after construction, because it would be easy to navigate, and because, with its slack water, the canal would be an especial aid to boats ascending the rapids.

The actual plans and estimates for the canal were done by Wilson's assistant, D.C. Jenne, who had previous experience in canal construction. Jenne's estimate of $3,390,000 to build the canal was not too far off, but his estimate that the work could be done by 1869 was 8 years too short.

Chief Engineer Humphreys found Colonel Wilson's report satisfactory and presented it to the House of Representatives in early February. Here the Committee on Commerce considered it and made provisions for the canal in the general appropriations bill. However, objections arose in the Senate when doubts were raised about the canal plan. Most previous Engineer reports had rejected the idea of a canal. The Senate rejected the item and in its place appropriated $500,000 for "improving navigation at the Des Moines or lower rapids, according to such plan as the Secretary of War shall, on the report of a board of engineers, approve."[36]

Accordingly, Humphreys convened a Board of Engineers which met at Keokuk on April 16, 1867, to examine the Rapids and make recommendations. The Board consisted of Wilson, T.J. Cram, Colonel Macomb, Major Warren, Captain Hains, and W. Milnor Roberts, who had been superintending engineer improvements on the Ohio River. After examining the Rapids, the members of the Board adjourned until April 30 when they reconvened at the U.S. Engineer's Office in Davenport, and remained in session until May 13.

In addition to the plans Colonel Wilson had previously considered, the Board investigated several other alternatives, including the possibility of dams across the entire river, Livermore's Improved Chute, and Brunet's Improved Float Gate for sluices in dams. The latter was a hollow gate hinged so that when the desired level of water in a sluiceway was reached the gate could be flooded, sinking it horizontally on the bottom, permitting the boat to ride the crest thus produced.

In the end, the Board's recommendations were almost identical to Wilson's original proposal, except that some of the dimensions were reduced. On July 19, 1867, the Board reported its results to the Secretary of War, who had been given power to make the final decision. He instructed Colonel Wilson to "proceed at once to carry out the plan of improvement reported by the board."[37]

The Board had decided that the canal was to be built by constructing an embankment in the water to form the river side of the canal, excavating the prism between the embankment and the shore to obtain a 5-foot depth. This embankment was to be built first because, being built out in the river, it was the most uncertain part of the construction; because, once built, it would serve as protection for building the locks; and because the total of $700,000 now appropriated for the canal would just about complete the cost of the embankment.

Colonel Wilson advertised in newspapers throughout the country in July for bids to construct the embankment and prism. Bids were opened September 4 at Davenport, and on September 25 Wilson signed a contract with William Henegan and Son of Mt. Vernon, Ohio.[38]

On October 18, 1867, Wilson, his assistants, and William Henegan located the centerline of the canal, and moved the first wagon load of earth for the guard bank connecting the outer

embankment of the canal with the shore. Regular work began the next day.

The contractors fell behind schedule almost immediately. The boats they had promised to provide had not yet arrived at the end of November, and fewer men had been hired than were necessary to keep on schedule. Nevertheless, there was some progress. By March 1, 1868, 5,000 feet of earth embankment had been laid 7 feet high, and 5,280 feet of rip rap wall had been put down. On shore 7,500 feet of new rail line and 76 rods of public highway had been completed to replace those taken by the project.

Early in March Colonel Wilson foresaw that problems with the contractor on the Des Moines Rapids would increase. With the work at the Rock Island Rapids going smoothly, Wilson requested that his station be changed from Davenport to Keokuk. He received the required orders, and by April 10, the headquarters of the Rock Island District had moved to Keokuk. Wilson retained this office in Keokuk until he retired in 1870. At that time, Colonel Macomb moved the office permanently to Rock Island.

After repeated admonitions from Colonel Wilson, Henegan and Son were declared to have violated their contract on October 26. Perhaps realizing they had undertaken too much, the contractors made little protest. Until a new contractor could be found, Wilson and his assistants took over the work using the machinery left behind by the contractor. That machinery included 4 boats (not powered), 18 double teams, 13 carts, 66 railroad cars and 2 locomotives. The two small locomotives had been built especially for this project, and were part of the shortest, smallest railroad in Iowa. The 4-foot tracks ran from the quarry on shore out over the top of the embankment. They were extended as the embankment was built. The railroad flat cars hauled stone from the quarry to the embankment while the dump cars were used to haul earth. There is some irony in the fact that the Rock Island District came into charge of a railroad and horses before owning a single boat.

On November 28, 1868, a new contract was signed with J.J. Dull of Harrisburg, Pennsylvania, who bought all the old machinery. The work went better under this contractor. During the 1868 season the average work force had been 15 foremen, 113 laborers, and 104 quarrymen. By 1870 the canal force was up to 1,000.

The finished embankment contained a total of 884,325 cubic yards of earth in addition to 97,000 cubic yards of rock excavated from the canal prism and from the chains at Nashville and Montrose. The embankment varied between 60 and 90 feet at the base, with a slope of 1½ to 1. It varied between 16 and 27 feet high.

Within the prism of the canal were two lift locks and one guard lock, completed between 1870 and 1874 after the embankment was finished under a separate contract made in 1868. The lower lift lock was located at Keokuk; the middle lock was 2.5 miles above the lower; and the guard lock was 1/10 mile above the middle lock. At each of the locks a 27-foot square stone engine house held the 30 horsepower steam engines used to operate the locks. This machinery was manufactured from an original design of Major Amos Stickney, who assumed local charge of the Canal in 1872. The machinery permitted the use of only one man at each lock to operate the gates.

The locks were constructed of magnesian limestone laid in hydraulic cement. The stone was quarried from the Sonora Stone Quarries on the bluff adjacent to the River. The lock gates were built of cedar and cypress wood which proved to be so sturdy that when the gates were removed for repairs 25 years later, workmen had trouble taking them apart.

Each lock provided a chamber 310 feet long by 80 feet wide at the surface, giving it a usable length of 291 feet by 78 feet. Larger boats could be locked through by maneuvering and using one gate at a time, but the only regular steamboat larger than 291 feet on the Upper Mississippi was the 302-foot *St. Paul*.

Delays caused by changes in contractors, by contractors' unfamiliarity with problems encountered, and by limited appropriations postponed completion of the Des Moines Rapids Canal far beyond its projected 1869 date and nearly doubled the costs. The Engineers frequently had to wait for new appropriations before resuming work.

Not all the delay was due to lack of money or faulty contractors. The Upper Mississippi Valley weather and the River itself were continually conspiring to show their power. A manifestation of this power occurred as the last section of the project was being completed—the cutting of a channel through the Montrose Chain above the Canal.

On August 24, 1875, contractors completed a coffer dam on the Montrose Chain enclosing 95 acres of river. On September 3 the dam sprang a leak, flooding the work in 40 minutes. This leak

was repaired by September 8, but on that day an unusually heavy rainstorm raised the small streams throughout the Upper Mississippi basin, and the river rose to the heights of the spring floods. The high water threatened the dam, so the contractors made a cut in the dam and flooded the pit. But the difference in elevation between the head and foot of the coffer dam caused a strong current which washed away 600 feet of the dam, and created a cross-current which caused a heavy log raft to float in and unship the engine and pump at the lower end. Engine, pump, and a number of small tools were lost in the river.

The water continued high, so repairs to the dam were not completed until October 12, at which time 900 men were put on the job of excavating until January 2, 1876. Then a repeat of the September 8 flood washed the dam away. This time the Chief of Engineers was consulted, who determined to go ahead. The dam was rebuilt and contractors began pumping the water out on January 31. During the pumping a cold snap formed 6 inches of ice on the water inside the dam which, settling on the tracks in the pit, caused considerable trouble. After removing the ice, the men resumed work on February 7.

Three days later, on February 10, a recurrence of soft weather and heavy rains threatened another overflow. A dredge was at hand, and by continuous effort for three days and nights, workmen raised the walls of the coffer dam above flood level.

With the river met and temporarily conquered, work resumed until February 24, when appropriations ran out and the work halted. But by this time all but a small patch at the head of the chain had been completed. Such a long series of hardships might have been unusual, but disappointment was an ever-present companion in the work of navigation improvement.

The Canal itself was not immune from troubles caused by contractors' subperformance and the whims of nature. In the spring of 1875 a large leak developed under the canal bank ½ mile below the middle lock. Engineers discovered a crevice in the bed rock of the river 2 to 4 feet below grade which was pouring thousands of gallons of water into the canal. To get at the crevice, half of the embankment for a length of 500 feet had to be removed, the channel excavated, and the crevice exposed and filled with concrete.

FIG 11. Guard lock at the Des Moines Rapids Canal.

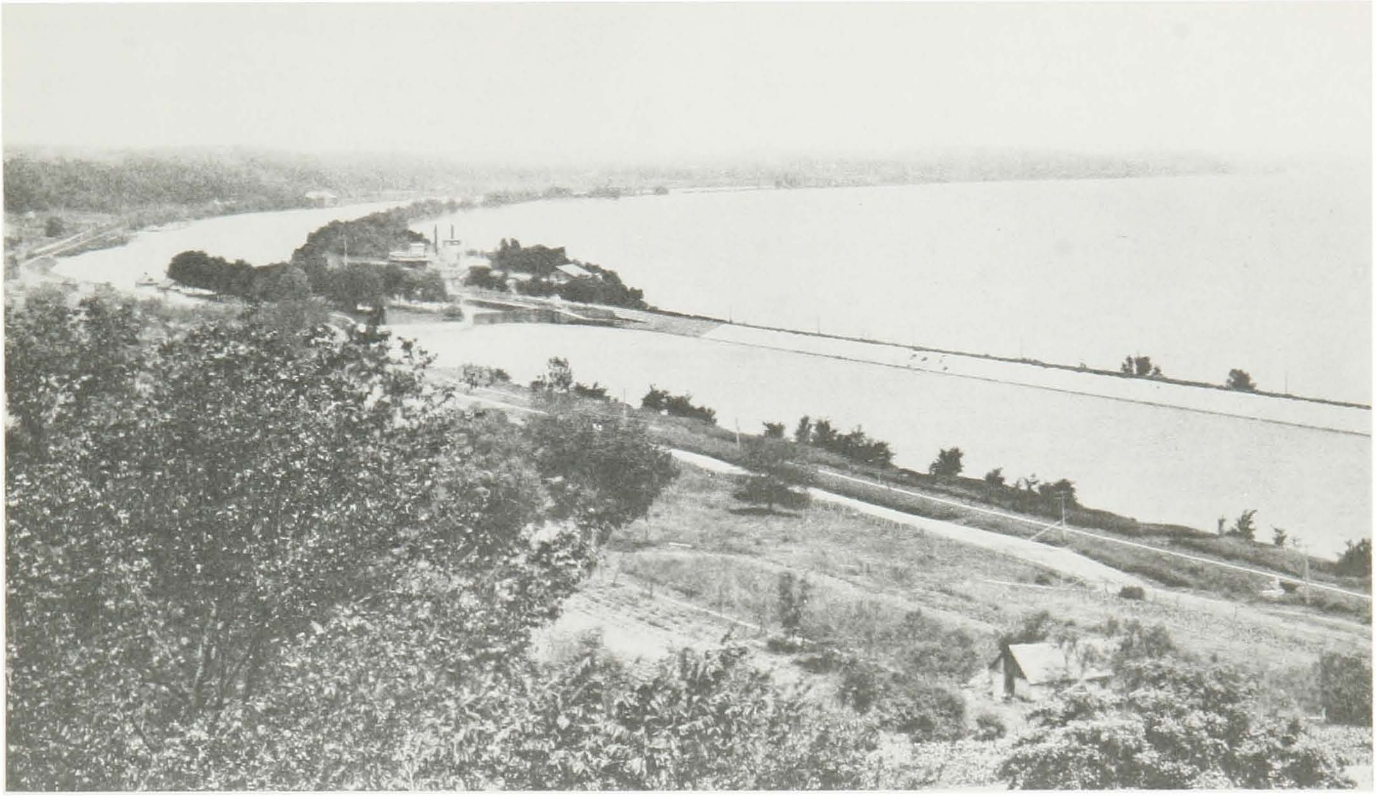


FIG. 12. Middle lock at the Des Moines Rapids Canal.

The Des Moines Rapids Canal was not opened to traffic until 1877. It had cost 4,155,000. On the morning of August 22, the Rock Island District sidewheel snagboat *Montana*, with District Engineer Colonel Macomb on board, and with colors flying, bands playing, and spectators who thronged both boat and shore cheering loudly, entered the guard lock at the head of the canal, becoming the first boat to enter. At 5 p.m. the Keokuk Northern Line steamer *Northwestern* entered the lower lock, passed the *Montana*, went up to the head of the Canal and came back at 9 p.m. Colonel Macomb reported that "the adjacent bluffs were lined with spectators."[39] The steamer *War Eagle*, one of the grandest boats on the Upper Mississippi, brought a large delegation from St. Louis for the event, but she ran aground on a sand bar below the rapids and missed the ceremonies.

Problems with the embankment of the Canal caused it to be closed for repairs on September 10 after only three weeks of operation. It was opened again on September 22, but closed for 15 days on October 1. On October 11-12, 1877, at a meeting of the Mississippi River Improvement Convention (one of the conventions that led to the formation of the Mississippi River Commission two years later), the Canal came in for severe criticism by rivermen. "Twelve years for nothing," one of the speakers called it. Protests against the Corps of Engineers included charges that the Government had hired a steamer at $50,000 per year to throw hunting parties for those building the Canal.[40]

Present at that convention was a relatively new employee of the Rock Island District, Montgomery Meigs. Meigs was the son of Lieutenant Lee's assistant, and was an assistant engineer at the Rock Island Office with the rank of United States Civil Engineer. When Meigs was given a chance to answer these charges, he outlined the problems, most of which he charged to contractors' failure to put the rock down correctly in the embankment, in so clear and reasonable a way that the members of the convention and the reporters present accepted his explanation. The mood of the convention toward the Corps of Engineers changed, and Meigs was referred to thereafter by the members as either "General" or "Major" Meigs.[41] Although Meigs had never been in the Army, the "Major" stuck, and throughout his long career with the Rock Island District, he was known as Major Meigs.

Montgomery Meigs grew extremely knowledgeable about District operations and served a series of District Engineers as an innovator and advisor. In 1884 he was put in local charge of the Des Moines Rapids Canal, where he remained until his retirement in 1926.

The Des Moines Rapids Canal continued serving steamboats on the Upper Mississippi until it was flooded out in 1913 by the new Keokuk water power dam. As part of the agreement with the Corps of Engineers, the Keokuk and Hamilton Water Power Company built a new larger single lock as part of the dam. Montgomery Meigs remained in charge of these new facilities. The power dam also flooded out the last vestige of the Des Moines Rapids as a 60-mile pool formed behind the dam.

## OTHER ACTIVITIES ON THE UPPER MISSISSIPPI 1866 TO 1877

While Colonel Wilson supervised the improvement of the Rock Island and Des Moines Rapids, Major G. K. Warren worked at a variety of activities between St. Paul and the Rock Island Rapids. In the fall of 1866 he began the surveys assigned to him. These were general surveys to locate areas needing improvement and to determine methods for doing so. Based on the surveys completed by the winter of 1866-67, Warren published a preliminary report on January 21, 1867, in which he recommended that money be appropriated for a lock and dam at Meeker's Island, for building and operating two dredge and snag boats, and for small experiments with wing dams, closing dams, and beacons—a total of $340,465.[42] Warren also requested $775,500 for a 4-foot channel between St. Louis and St. Paul, or as an alternative, $117,000 for a 2 or 3-foot channel.

On March 2, 1867, Congress appropriated money for two snag boats for the Upper Mississippi, one snag and dredge boat for the Wisconsin River, and $37,000 for removing snags and boulders from the Minnesota River by contract.

Meanwhile, Warren completed a more extensive survey of the Wisconsin River and laid down a canal route from Portage City to Prairie du Chien. Warren considered this the most reliable means of obtaining navigation from Green Bay to the Mississippi River. He estimated that such a canal following the natural river valley and using the Wisconsin River for crossings would give a 4-foot depth for just over $4,000,000.

Following completion of his surveys, Major Warren next looked into purchase of the snag boats provided for in the March appropriations. Following adjournment of the Board of Engineers which met at Keokuk to consider the Des Moines Rapids in the spring of 1867, Warren left for St. Louis and Cincinnati to examine available boats which could be adapted to snagging operations. He returned to St. Paul on June 9. During June, Warren placed ads in several newspapers inviting bids for selling steamboats to the United States to be used for scraping sandbars, and also for contracts to remove snags from the Minnesota River.

A satisfactory bid was received for snagging the Minnesota River, but bids for snag boats were too high and involved unsuitable boats. Early in September, Warren returned to St. Louis and, after careful examination, decided to buy two sidewheel boats, the *Montana* for $30,000 and the *Caffrey* for $8,500. Major Warren had already purchased several small skiffs and a quarterboat for his surveys in the fall of 1866, but these two boats were the first Corps-owned steamers on the Upper River. In September of 1868 Warren bought a third boat, the small steamer *Winneconne*, for $8,500. The *Winneconne* was intended for the Wisconsin River improvement, but proved to have too great a draft.

Prior to the spring season of 1868, Warren adapted the *Montana* and *Caffrey* for Corps work. Both boats were fitted with a Warren adaptation of Stephen H. Long's Scraper, a row of steel half-cylinders attached to a wooden beam dragged along the bottom of the channel. In addition, the *Montana* was strengthened and fitted with boom machinery for snagging.

Long's Scraper improved a channel by stirring up sand on the river bottom so that the current could carry it away. A scrape across a bar took from 4 to 10 minutes. Depending on the size of the bar, clearing a channel deep enough for steamers to pass took from an hour to an entire day.

Warren's experiments in channel improvement showed gratifying results the first season. During 1868 the *Montana* worked 67 days and the *Caffrey* worked 112. When the *Caffrey* began work on July 12, the water was so low that large boats could not navigate. The scraping of bars by the *Caffrey* made it possible for all boats to operate for the rest of the season. The

FIG. 13 The Rock Island Bridge, built under the supervision of General G. K. Warren and Colonel J. N. Macomb in 1869-72. The present structure was extensively remodelled in 1894-95, with iron replacing most of the old wooden structure. A faint image of the original wooden bridge can be seen in the background of Fig. 38.

one problem with scraping as a means of channel improvement was that it was not permanent. The next cycle of high-low water would leave an entirely new set of bars up and down the river.

Warren also pioneered the marking of the channel to guide pilots during the 1868 season. When the *Montana* or *Caffrey* had put a section of channel in good condition, the crew would place guide boards on either side of the river along the banks. The guide boards were three quarters or one-inch boards held together by cleats, about five or six feet square. They were painted white with a large red cross in the center, and fastened twenty or thirty feet above ground on trees. Steamboat pilots at first ridiculed these guides, but by the close of the season there was universal acknowledgment of their benefit, especially on dark, cloudy nights.[43]

In the fall of 1868 Major Warren was sent West as a special commissioner to examine the construction of the Pacific Railroads under direction of the Secretary of the Interior.[44] He did not return until June of 1869.

On his return, Warren was put in charge of construction of the new railroad bridge at Rock Island. This bridge had been authorized in 1866 when the Government determined to relocate the tracks of the railroad to the southern tip of the Island of Rock Island to facilitate use of the Island as a United States arsenal. A new bridge had already been designed by General Rodman, Commandant at the Arsenal. It was to include two levels, one for a railroad and the other for a wagon road. In the spring of 1869 the Government decided to place the job with the Corps of Engineers, partly to permit better coordination with navigation problems.

Disagreements over the bridge had existed throughout the planning stage. Some interests

wanted the wagon road on the upper level, others felt it should be on the lower. Original plans called for a double track bridge, but General Rodman had also designed plans for a single track bridge.

There were also limitations of money. Congressional authorization for the bridge stipulated that the Government and the railroad company share the cost equally, with the Government half not exceeding $1,000,000. Because of these problems, only the piers had been contracted for, designed so they could take either a single or a double track bridge.

Major Warren made several changes in Rodman's plan. He redesigned the bridge to have the wagon road beneath the railroad so as not to let the trains frighten the horses, and to make easier access to roads in Davenport. He designed a one-track bridge with the wagonway 30 feet above low water and the railroad track 12 feet above the wagonway. Warren also redesigned the drawspan, placing it next to the island shoreline (which General Rodman claimed would interfere with steamboat landings at the Arsenal). The 366-foot drawspan which Warren designed to operate on a pivot was by far the heaviest drawspan operating on that principle yet built.[45] The bridge was 1,546 feet long and cost $999,261.

On August 3, 1869, in order to supervise construction of the bridge, Major Warren requested that his office for bridge matters be changed to Rock Island, retaining his St. Paul Office for other works in his charge. On May 27, 1869, Colonel Wilson's sub-office in Davenport had also been moved to Rock Island, perhaps because boats were easier to dock on the Rock Island side of the river.

Warren was occupied with bridge construction until the following June when he was put in charge of the Lakes Survey with headquarters in Detroit, ending his long service to the Upper Mississippi River. He was replaced by Col. J.N. Macomb, who had been Superintendent of Western River Improvement.

Colonel Macomb established his office on the second floor of a commercial building at the northeast corner of 19th Avenue and Second Street in Rock Island. This office was across the street from Spenser Square and the Harper House, one of the notable hotels in the Mississippi Valley. These quarters remained as the main Engineer's Office of the Rock Island District until 1896, when the Corps moved into the newly-completed Federal Building.

When Colonel Wilson resigned from the Army in October of 1870 to become Vice President of the St. Louis and Southeastern Railroad, Colonel Macomb assumed his duties in addition to Warren's.

Under Macomb work continued on the Rock Island Bridge. By the fall of 1872 it was nearing completion. On November 18 running ice in the Mississippi stopped the ferry between Davenport and Rock Island. In response to a request from the Arsenal, Macomb opened the bridge to traffic the next day. Trains had been crossing the bridge since October 8.

The *Montana* and *Caffrey* continued to operate with great success. During the 1872 season the *Montana* ran 4,089 miles and the *Caffrey* ran 2,641 miles in pursuit of their duties. But by 1877 when Major Farquhar assumed command of the Rock Island District, the boats were beginning to show the effects of hard work. 1877 was the last season for the *Caffrey*. Because of low appropriations that year, she was not put in commission, and was sold soon after. The *Montana* continued to operate until the close of the 1878 season, when she was rebuilt into a completely different boat.

By 1873 the partially improved Rock Island Rapids were less of an obstruction than the channel north to St. Paul. Under Colonel Macomb the first permanent improvement of this section of the river was begun in 1873 when the crew of the *Montana* closed the chute at the head of Pig's Eye Island, five miles below St. Paul, after navigation had become blocked there. A jetty was built from the head of the island to the eastern shore, followed by similar jetties at Rollingstone Bar and at the head of Betsy Slough above Winona, Minnesota.[46]

These jetties were built by driving piles close together and then placing two-inch planks on the upstream side. When the *Montana* returned to Pig's Eye Island, she found that the jetty had given way. C.W. Durham, who was in charge of the experiments, decided to build a wing dam by driving two tiers of poles along the length of dam 9 feet apart, and filling the space with willow brush weighted down with sacks of sand. The finished wing dam was 600 feet long, and varied between 6 and 10 feet high. Within days, this dam had opened the channel. Furthermore, it remained open, a permanent improvement.

Colonel Macomb also undertook the first comprehensive surveys of the Upper Mississippi under an 1874 appropriation for Transportation Routes to the Seaboard.[47] Major Warren's surveys in 1866 had only been of selected locations. If the Corps of Engineers was to

develop a plan of permanently improving the channel, they would need a more complete survey.

Consequently, when Montgomery Meigs joined the Rock Island District in 1874, his first assignment was to carry out such a survey. A quarterboat, the *Hoffmann* (named after the engineer in charge of the Rock Island Rapids), built just for this survey, was finished on August 27 and towed to St. Paul by the *Montana*.

With C.W. Durham as his assistant in charge of the sounding party, Meigs began the survey at Frenchman's Bar, 1½ miles below St. Paul, on September 2. There was only time and money to do the worst stretch of river, that part between St. Paul and La Crosse. In that area the survey crew located 44 sandbars that were obstructions to navigation. 23 of these had 3 feet of water or less at low water.

The quarterboat *Hoffmann* did not use a steamboat on this trip to move from location to location. Instead, Montgomery Meigs rigged up a sail which proved satisfactory enough to maneuver downstream. Meigs reported that he kept the boat close to shore because "she doesn't have very good sailing qualities."[48] During this trip he also adapted a rowboat for use on Lake Pepin by adding a false keel and installing a sail he bought from a fisherman for $2.50[49] These were the first examples of Meigs' tinkering that would eventually produce a superb fleet of boats for the Rock Island District.

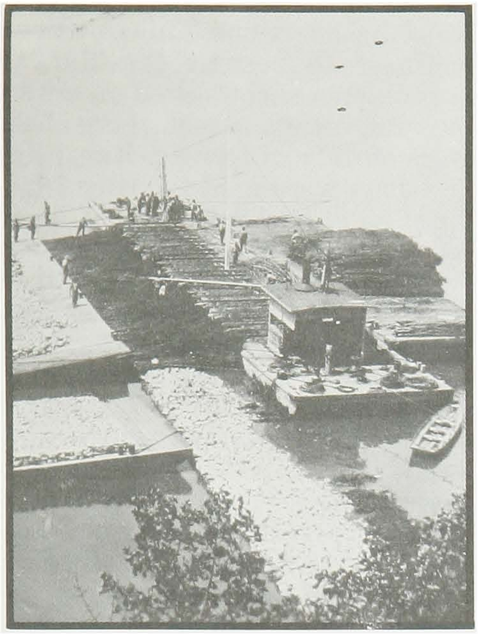
In his report of this survey, Meigs recommended that wing dams similar to the one constructed at Pig's Eye Island be used to constrict the channel in order to deepen and scour it. In 1878 when the 4½-foot channel was adopted, wing dams became the predominant method of achieving that goal.

FOOTNOTES

Chapter III

1. Lippincott, p. 632.
2. *Annual Report*, 1892, II, p. 1760.
3. Lippincott, p. 633.
4. *Proceedings of the Mississippi River Improvement Convention Held at Dubuque, Iowa, February 14 and 15, 1866* (Dubuque: *Daily Times*, 1866), p. 3.
5. *Ibid.*, p. 39.
6. U.S., Congress, House, *Letter from the Secretary of War, in Answer to a Resolution of the House, of December 20, 1866, Transmitting a Report of the Chief of Engineers, with General Warren's Report of the Surveys of the Upper Mississippi River and Its Tributaries*, report of G. K. Warren, Executive Doc. 58, 39th Congress, 2d Session, 1867, p. 2.
7. Major G. K. Warren to Chief of Engineers, August 27, 1866, File 25, Letters Received, RG 77, NA.
8. *Ibid.*
9. James Worrall to Lt. Col. Wilson, August 16, 1866, Rock Island District Historical Files.
10. Colonel J. H. Wilson to Chief of Engineers, August 26, 1866, File 25, Letters Received, RG 77, NA.
11. Keokuk *Gate City*, August 26, 1866, p. 4.
12. Colonel Wilson to Chief of Engineers, October 1, 1866, File 25, Letters Received, RG 77, NA.
13. *Davenport City Directory for 1870.*
14. War Department, *Annual Reports, Report of the Chief of Engineers*, 1867, p. 270.
15. U.S., Congress, House, *Report of Brevet Maj. Gen. James H. Wilson, Lieutenant Colonel Thirty-fifth Infantry, on the Survey of the Rock River in the States of Illinois and Wisconsin*, Executive Doc. 15, 40th Congress, 1st Session, 1867, p. 1.
16. James Worrall to Colonel Wilson, October 17, 1866, Rock Island District Historical Files.
17. *Ibid.*
18. *Report of Brevet Maj. Gen. James H. Wilson*, p. 8.
19. *Ibid.*, p. 9.
20. *Ibid.*, p. 10.
21. Colonel Wilson to Chief of Engineers, January 1, 1867, File 25, Letters Received, RG 77, NA.
22. *Annual Report*, 1867, report of Capt. Peter C. Hains, p. 293.
23. General Warren is quoted on this point in C. W. Durham, "A History of the Improvement of the Rock Island Rapids, Mississippi River," *Annual Report*, 1886, III, pp. 1429-1472. Captain Haines also mentions the problem in his report, *Annual Report*, 1867, p. 294.
24. The source for this information is an unsigned, handwritten manuscript found in the Rock Island District files.
25. *Annual Report*, 1886, II, p. 1431.
26. *Ibid.*, p. 1428.
27. Donald Enders, "The Des Moines Rapids: a History of Its Adverse Effects on Mississippi River Traffic and Its Use as a Source of Water Power to 1860" (unpublished Master's thesis, Dept. of History, Brigham Young University, 1973), p. 62.
28. Fort Madison *Patriot*, April 18, 1838.
29. Ben Hur Wilson, "Over the Rapids," *Palimpsest*, IV (November, 1933), 362.
30. *Ibid.*, p. 363.
31. *A Memorial to Congress to Secure an Adequate Appropriation for a Prompt and Thorough Improvement of the Mississippi River* (St. Louis: John J. Daly and Co., 1881), p. 12.

32. *Annual Report*, 1867, p. 329.
33. Keokuk *Gate City*, August 23, 1866, p. 4.
34. Samuel R. Curtis was a West Point Graduate of the class of 1831. However, he resigned his commission in the Corps of Engineers the following year and spent most of his life in the Midwest as a civil engineer for private and state concerns. He surveyed many of the railroads in Iowa as well as the Des Moines River. From 1857-1861 he served three terms as a U.S. Representative. A longtime resident of Keokuk, he was the kind of man whose advice Col. Wilson would have taken seriously. Curtis died on December 26, 1866, several months after Col. Wilson's arrival.
35. "Early Plan of Canal," typed, unsigned mss in the Historical Files, Keokuk Public Library, Keokuk, Iowa.
36. *Annual Report*, 1867, p. 265.
37. *Ibid.*
38. Unless otherwise noted, the material here and on the following eight pages is from the *Annual Reports*, 1867-1870.
39. *Annual Report*, 1878, I, p. 734.
40. St. Paul and Minneapolis *Pioneer Press*, October 12, 1877.
41. *Ibid.*
42. House Doc. 58, 39th Congress, 2d Session.
43. *Annual Report*, 1869, p. 202.
44. *Annual Report*, 1875, I, p. 382.
45. U.S., Congress, House, *Letter from the Secretary of War, Transmitting a Report of the Chief of Engineers upon the Rock Island Bridge, January 10, 1870*, report of G. K. Warren on the bridge to A. A. Humphreys, Executive Doc. 31, 41st Congress, 2d Session.
46. *Annual Report*, 1874, I, 302.
47. "Reports upon Transportation Routes to the Seaboard," Appendix CC of the *Annual Report*, 1875.
48. Montgomery Meigs to Colonel Macomb, October 6, 1874, Rock Island, Rock Island District Historical Files.
49. Montgomery Meigs to Colonel Macomb, October 11, 1874, Rock Island District Historical Files.



CHAPTER IV

# STOPPING THE LEAKS: THE 4½-FOOT CHANNEL

When Major F. U. Farquhar became District Engineer on November 15, 1877, the Rock Island District was firmly established as a force on the Upper Mississippi River. The period of experimentation and isolated projects was coming to an end. The Des Moines Canal had just opened, the Rock Island Rapids were navigable, and the experiments with wing dams and dredging had proved their point.

There were still critics who talked about "Humphreys and his corpse of engineers,"[1] but all along the River the Corps was growing up. The controversial Eads Jetties at South Pass had been authorized on March 3, 1875. The ship channel which they scoured to the Gulf of Mexico once again made water shipment to New York competitive with the railroads. By 1878 the jetties had proved themselves, increasing the demand for further improvement of the channel to St. Paul.

River improvement conventions which had grown to be a popular means of applying pressure to Congress before the Civil War now increased in number and voice, all requesting far more extensive channel improvement. Conventions met at St. Louis in 1867, 1872, 1873; at New Orleans in 1869, 1876; at St. Paul in 1875, 1877; at Prairie du Chien in 1868. Even after passage of the 4½-foot channel project conventions continued to meet to keep the pressure on and the appropriations coming.

District Engineer Colonel Mackenzie attended one of these larger conventions at St. Louis in 1881, shortly after the improvement work had begun. The members were interested in exactly what the Corps intended to do, and how fast. But Colonel Mackenzie, after answering a few brief questions, asked to be excused "inasmuch as I would greatly prefer, as heretofore, to carry on the practical work, than to appear as a public speaker."[2]

The Act of June 18, 1878, authorized a 4½-foot low water channel from St. Paul to St. Louis, to be accomplished by contraction of the channel through wing and closing dams, and eventually to be increased to 6 feet. The Act appropriated $250,000 for improving the channel from St. Paul to the Des Moines Rapids, and $100,000 for channel improvement from the Rapids to the mouth of the Ohio River.

The 4½-foot channel project caused a change in the method of operations in the District from many scattered duties to one unified project. When Major Farquhar became Rock Island

District Engineer he assumed command of 17 separate river improvement projects ranging as far as the Red River of the North. On July 15, following passage of the 4½-foot channel, Farquhar was relieved of all improvement work above St. Paul. Even operation of the Des Moines Rapids Canal was placed under the separate command of Major Amos Stickney. The 4½-foot channel became the Rock Island District's single most important purpose.[3]

Preparation for channel improvement was begun even before the Act was passed. During the winter of 1877-78, Farquhar had a general map of the Mississippi River drawn up. The map covered the River from the Falls of St. Anthony to the mouth of the Illinois River, and was a composite of all the prior maps and surveys in the Rock Island Office. The map was photolithograped in 26 sheets and distributed to rivermen with the hope that it would induce a more uniform nomenclature of localities, a needed step for river improvement.

The first step in the 4½-foot project after the Act was passed was to make yet another survey of the River. The survey made by Meigs in 1874 had only gone as far as La Crosse. In 1875 C.W. Durham had continued this survey to Keokuk. But no thorough survey had ever been made south of the Des Moines Rapids. Even the sections of the river that had been surveyed had changed so much in four years that the Meigs and Durham surveys were useless.

Consequently, the first comprehensive survey of the River from St. Paul to Grafton, Illinois was begun under Major Farquhar during the 1878 season, and finished in the fall of 1879. Seven separate survey parties were assigned sections of the river. Each party consisted of 24 men: 2 assistant engineers, 1 pilot, 3 recorders, 1 clerk, a transit party of 6, a level party of 4, a sounding party of 5, and laborers to build sounding stations. Equipment for each party included a 34- by 8-foot steam launch, a 40- by 10-foot quarterboat (used as a cook house and office), 3 rowboats, and 5 12- by 12-foot tents. The whole camp moved 8 to 12 miles at a time.

The map prepared from this survey was published in 83 sheets, and excluded only the Rock Island and Des Moines Rapids.

Major Farquhar also continued the practice begun by Colonel Macomb of dividing the District up into sub-sections (called "districts" or "divisions" in District correspondence). Farquhar placed an assistant engineer in charge of each sub-district. By June of 1879 when Colonel Mackenzie arrived as District Engineer, there were five of these sections. This practice allowed each engineer to become familiar with the peculiar problems encountered on his stretch of river—an important asset, considering the short tours of duty of District Engineers.

Preparations were made during 1878 for expansion of the District fleet of boats. The *Montana* which had served the District for 14 years was condemned at the end of the 1878 season, and her machinery transferred to a new hull at the D.S. Barmore shipyards at Jeffersonville, Indiana. The new snagboat, the *General Barnard*, became part of a growing fleet of steamboats owned, operated, and in many cases designed and built by the Rock Island District. At its height in 1910 the District fleet made up nearly twenty percent of the total number of steamboats operating on the Upper Mississippi.

Under Major Farquhar's direction, engineers in the District began to develop improved equipment. The old chisel boats with their ponderous machinery had never been very efficient, being able to break an average of only ten cubic yards of rock per day. In September of 1878 Farquhar designed and built a new steam drill scow for subaqueous blasting, hoping to improve on the performance of the chisel boats. The steam drill was built on a decked flatboat furnished with three spuds and head and side lines. On this deck was placed an upright boiler 57 by 42 inches which was used to power a 4-inch Ingersoll drill. The drill was attached to the boat's cross head, and hinged so that it could be inclined at any angle.

In October the new steam drill and an old chisel boat were towed up to the Moline Chain on the Rock Island Rapids and tested side by side for 45 days. The steam drill and blasting operation broke an average of 17 cubic yards of rock per day, 7 more than the chisel boat. The chisel boat had cost $4,500 to build, while the steam drill had cost only $1,800.

District operation entered a new, expanded phase shortly after Colonel Mackenzie's arrival with construction of the Des Moines Rapids Canal Dry Dock and the Canal Shops at Keokuk. Montgomery Meigs, whose first love was boats, was responsible for the idea, design, construction, and operation of the dry dock and shop, built alongside the Des Moines Rapids Canal.

Meigs convinced Colonel Mackenzie to submit the dry dock project to the Chief of Engineers in 1882. A dry dock was badly needed; no other existed anywhere on the Upper Mississippi. Whenever a boat of the growing

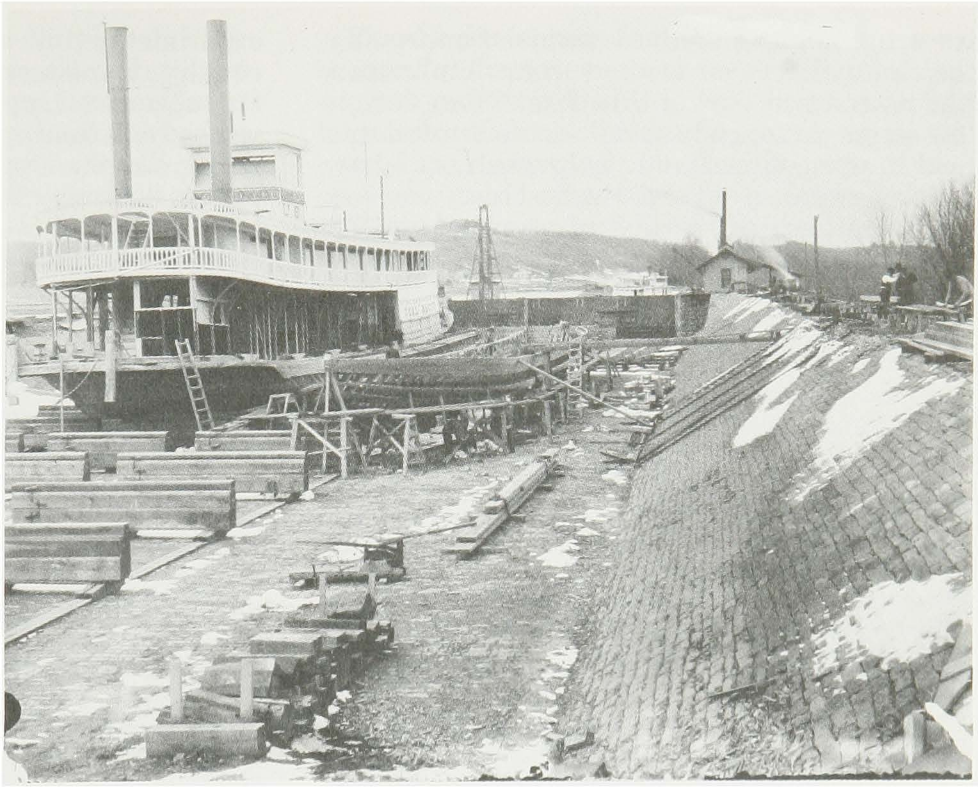


FIG. 14 The Government steamboat *Coal Bluff* on the ways at the Des Moines Rapids Canal Dry Dock.

District fleet needed repair or re-building, it had to be dragged onto ways on shore. The project was approved in February, 1883, and by April Meigs was at work supervising construction. The dry dock was built at a cost of $133,000 (under five separate appropriations) and finished in 1889. As had been the case with the last few years of construction on the Canal itself, the work was done by hired labor. Meigs never approved of contract work and was always handy with statistics to show how much more cheaply the Corps could do its own work.

The dry dock was situated on a piece of low ground on the river side of the Canal embankment just above the middle lock. It furnished a basin 400 feet long and 100 feet wide, with entrance from the Canal through gates giving an 80-foot opening. The outer embankment was of clay covered by rip rap. At the lower end of the dock were placed the canal shops, machine and storage sheds for boat building and repair.

Filling and emptying the dry dock was done by culverts opening into both the river and canal, and fixed with closing valves. The inlet was at the head and the outlet was at the foot of the pit. Up to a water stage of about 6 feet above low water the dry dock could be drained directly into the river; between a 6 and 12-foot stage drainage was into the canal. Stages above 12 feet required the assistance of a 12-inch rotary pump.

Because the Government dry dock was the only one on the River, the District established a policy that welcomed private boats in for repairs when District boats were not using it. The rate charged ran from $15 per day for boats of under 200 tons to $25 per day for boats over 500 tons.

The dry dock was flooded out by the same power dam that submerged the Canal. The power company built a new dry dock alongside the new lock near the dam.

With preliminary plans and preparations made, Colonel Mackenzie turned to supervision of the first concentrated effort at channel improvement using wing dams. The experiments with wing dams at Pig's Eye Island and other locations in 1873 had proved so successful that the *Montana* had spent a part of each season since then in similar experiments. During the 1879 season, however, work began in earnest. Several thousand feet of wing and closing dams were built at eight locations. Most of this work survived the flood the following spring which brought the highest water ever known on the Upper Mississippi to that time.

Wing dams were not new on the Upper Mississippi. Rivermen had long been pleading

for wing dams as the best means of improving the channel because of the success lumbermen had with variations of this dam. Often during low water raftsmen had built crude brush dams held in place by stakes to help wash out a bar, but these washed out with the first high water. A more complicated method of scouring a deep channel was developed by early raftsmen on the Chippewa and Wisconsin Rivers. An assistant engineer, J. DuShane, explained this method in an 1895 letter:

> The practice was to separate a raft into strings, then float two strings down to a shoal place, sticking one string on one side of the river and one on the other a sufficient distance apart and in funnel shape, the smaller opening being down stream, thus directing a greater volume of water into the narrow opening and producing a scour at and below the opening; then the other strings would be floated down, extending below those first stuck, until a cut through the bar was made. The rafts above would then be sent through in pieces, and the parts stuck on the bar forming the shear *(sic)* dams would be separated into cribs, which would be hauled into deeper water and sent through the newly made channel and re-rafted below.[1]

Wing dams had been used on the Ohio and Illinois River to deepen the channels. While they were more sturdy than the raftsmen's makeshift dams, they seldom lasted more than several seasons before deteriorating. Later wing dam experiments on the Missouri River proved equally transitory. Only in Europe, on the Danube and Upper Rhine, had wing dams worked as a lasting improvement. Both of these rivers, like the Upper Mississippi, had shifting, sandy bottoms. Wingdams built in the Rock Island District were almost identical in construction to those on the European Rivers.[5]

On the Upper Mississippi the wing dam proved to be an easy and permanent solution. In spite of the canalization of the modern Mississippi by locks and dams, wing dams are still in use and new ones are still being constructed. Many of the dams built in the 1880's are still in good shape today. Pieces of willow dug out of the dams after being in the water for ninety years still float.

To understand why such a relatively simple method of channel improvement worked so well on the Upper Mississippi, it is necessarv to understand the nature of that section of river. The Upper Mississippi is really two streams, one above the other. The upper stream is water flowing at about two to three miles an hour. Beneath this stream is a sandy bottom. This bottom is, in fact, another stream, moving much more slowly than the water above it. Currents agitate this sand stream and push it downriver. As it moves it forms bars and islands, diverting

FIG. 15. The Keokuk and Hamilton Water Power Company lock and dam built in 1912. The pool created by this dam flooded out the Des Moines Rapids and the Des Moines Rapids Canal.

the water into new channels. With each high water or spring flood the old bars are flattened out. When the water falls the even bottom leaves the whole area with shoal water. At this point the water cuts a new channel or channels through the sand, in which bars again begin to form.

Assistant Engineer C.W. Durham expressed the problem well:

Could the river seek out for itself under these circumstances a *single* channel, no trouble would be had, but being divided by islands, in a great many cases several channels are formed, sometimes of nearly equal size and depth, so that the water being thus divided, there is not a sufficient amount concentrated in any one channel to give the needed depth.[6]

Wing dams worked because they provided the necessary constrictions by forcing the water to scour one main narrow channel. Or, in the words of the rivermen, wing dams "stopped the leaks."

Sandbars and shoal water provided the most difficulty from La Crosse north. From the Wisconsin River to the Rock Island Rapids the 1878 survey showed only 25 bars; between Keokuk and the mouth of the Illinois River there were only 38 bars. But in the short stretch between St. Paul and the Mouth of the St. Croix, the worst part of the River, nearly every one of the 25 crossings had shoal water of three feet or less. Along this 29.7 miles of river there were 29 bad bars. The whole section from Read's Landing (at the foot of Lake Pepin) to La Crosse was clogged with sand from the Chippewa River and contained 46 bars needing improvement. During many seasons the upper limits of navigation in low water had been La Crosse or Winona.

Wing dams worked by constricting the channel. The natural width of the Upper Mississippi varied from 350 feet to 1,400 feet at the mouth of the Missouri River. The wing dams created a channel that was 1,200 feet wide or less. Each section was constricted to the width necessary to produce 4½ feet of water. The dams were built to four feet above low water. During high water the wing dam had little effect since the water flowed over the top. During low water, however, the current was confined to the new narrower channel. This increased its velocity, causing the current to scour out the sandy bottom until the new channel had attained the same area cross section as the wider natural channel. When equilibrium was reached in this narrower but now deeper channel, the souring action stopped. Wing dams were also used to aim the current in a given direction so as to wash away an unwanted bar or sand island.

The Rock Island District engineers never adopted a formal comprehensive plan for the 4½-foot project. Not until 1897 when District Engineer Colonel W.R. King drew up a provisional plan for the project was there anything but a year-to-year operation. In the 1880 *Annual Report* Colonel Mackenzie replied to Congressmen who had criticized this lack of planning:

A general plan with estimates has been prepared, but it is liable to so many alterations of detail due to changes of the river and experience gained as the work progresses, that it is deemed more proper to simply present projects from year to year for the work which can be accomplished with the amounts then available, selecting for improvement the points known to be most troublesome.[7]

Other critics complained that the practice of small annual Congressional appropriations kept the work to a slow pace. But the District was comfortable with this. Moving slowly gave the River herself a chance to participate in the work. The natural scouring of the river could have been hurried by dredging, but it was more economical to let the river do it. In addition, each new wing dam created new water conditions downstream. It took time for these to develop and to show a need for further improvement.

One interesting discovery made by Engineers as the work of river improvement continued was that not all of the channel obstruction was natural. DuShane, the Assistant Engineer at St. Paul, discovered that in all of the improvements made above Lake Pepin, the bars removed were found to be "largely composed of sawdust"[8] and other sawmill refuse which had been dumped in the river. Sawdust was found in bars as far south as Winona.

In 1888 the Engineers were called to remove a bar forming near the St. Paul waterfront. Dredging discovered that this bar was formed entirely of garbage. The area had been shoaling for several years; the Corps was called in only when the smell became so great that private citizens obtained an injunction against the cities. Minneapolis dumped 500 tons of garbage a day just below the Falls of St. Anthony, and St. Paul added even more.

Wing dams proved to be an exceptionally economical method of river improvement. They were made of willow mats and crushed stone, both readily available along the whole Upper Mississippi Valley. Crews were able to put in several hundred feet of dam a day.

The first wing dams on the Upper Mississippi were built by the Corps fleet using hired labor, but after these early experiments developed the

design, most of the rest were built by contractors. This would not have been possible without adoption of the 4½-foot channel project and the assurance it gave contractors that there would be enough future work to pay for building the equipment necessary to construct the dams. A wing dam fleet consisted of a steamboat, enough quarterboats for the crews as they moved up and down the river, and a variety of barges to haul stone and willow and on which to make the brush mats.

The contractors who held the record for the amount of wing dam construction was the partnership of Albert Kirchner and Jacob Richtman of Fountain City, Wisconsin. These men received their first contract in 1878 just after the 4½-foot channel was adopted; When World War I put an end to appropriations in 1917, Kirchner was still operating as sole owner of the company.

Kirchner and Richtman assembled a fleet consisting of a steamboat (or rather, a succession of them, including such boats as the *Percy Swain,* long a well-known excursion boat between La Crosse and Alma, Wisconsin) three quarterboats, two building boats, a light launch, and 18 barges. A commissary boat selling soap, tobacco, and other sundries serviced this floating town.

Large barges about 100 feet long, 20 feet wide and 5 feet from deck to bottom hauled the broken rock and willow bundles (known as brush). Two small 30-foot barges called hoppers were used in weaving the willow into mats for the dams. The building boats were the largest of all. They were equipped with boilers and engines, steam and hand capstans. Their purpose was to hold the course along which the dam was to be built. They could propel themselves with lines anchored on shore and out in the river, and could pull barges into position.

Contracts for wing dams were usually let by the Rock Island District in late fall or early winter, the work to be done the following summer.[9] The contractor agreed to furnish "all boats, materials, machinery, tools and other appliances necessary to do the work"[10] at points specified by the Corps.

Material for the wing dams consisted of alternate layers of willow mats and stone. By terms of the contract the willow had to be recently cut, and trimmed so that the poles could be gathered into tight bundles, or fascines, 20 feet long and from 12 to 15 inches in diameter, tied with lath yarn or wire at 4-foot intervals.

These bundles were laid side by side on the hopper and lashed together by three or more willow poles on top and bottom to form a mat 12 feet long. (See illustration on page 121.) The completed mat was pushed off the hopper, floated into position on the wing dam, and sunk with rock from the stone barges.

Rock was obtained from the bluffs along the river, some from private sources and some from Government quarries that were opened and closed as the work progressed along the river. The rock had to meet a specification of six inches, cubed, or its equivalent, but not larger than ten inches. Two-wheeled, one-horse carts brought the rock from the quarries to the barges. It had to be loaded uniformly on the barges to keep the barge level and so that inspectors could measure and mark down the amount of rock used. Thirty men worked on the stone barges, tossing rock off onto the willow mats.

A wing dam went up quickly. The bottom layer of brush was covered with rock from 6 inches thick at the upriver side to 18 inches at the lower. A second layer of brush was laid on this rock 10 to 15 feet further upstream than the lower layer, and covered with rock in the same proportions as the lower layer had been. Additional layers of brush were laid and covered with rock as needed to make the correct height, with each new layer placed an additional two feet upstream. The finished dam was high enough (generally four feet above low water) so that its top was above water except when the river was high.

An item as important as the wing dams was bank protection, or revetment. At the shore end of the wing dam revetment was necessary to prevent the current from washing the shore away, rendering the dam useless. The completed dam would often deflect the current toward the opposite shore. Bank protection was needed at those places, too. Even straight sections of shoreline were often subject to wearing, and needed revetment.

Although most of the improvement in the 4½-foot project consisted of wing dams, closing dams similar to that built at the head of Pig's Eye Island in 1873 were also built. By closing off chutes, by-channels, and sloughs, closing dams helped direct the current into the main channel. Closing dams were far more dangerous to build than wing dams because of the currents produced by shutting off a channel.[11]

The decision as to where to place wing dams was made by District engineers who surveyed out the line of each dam prior to the beginning of contract work. Wing dams were generally spac-

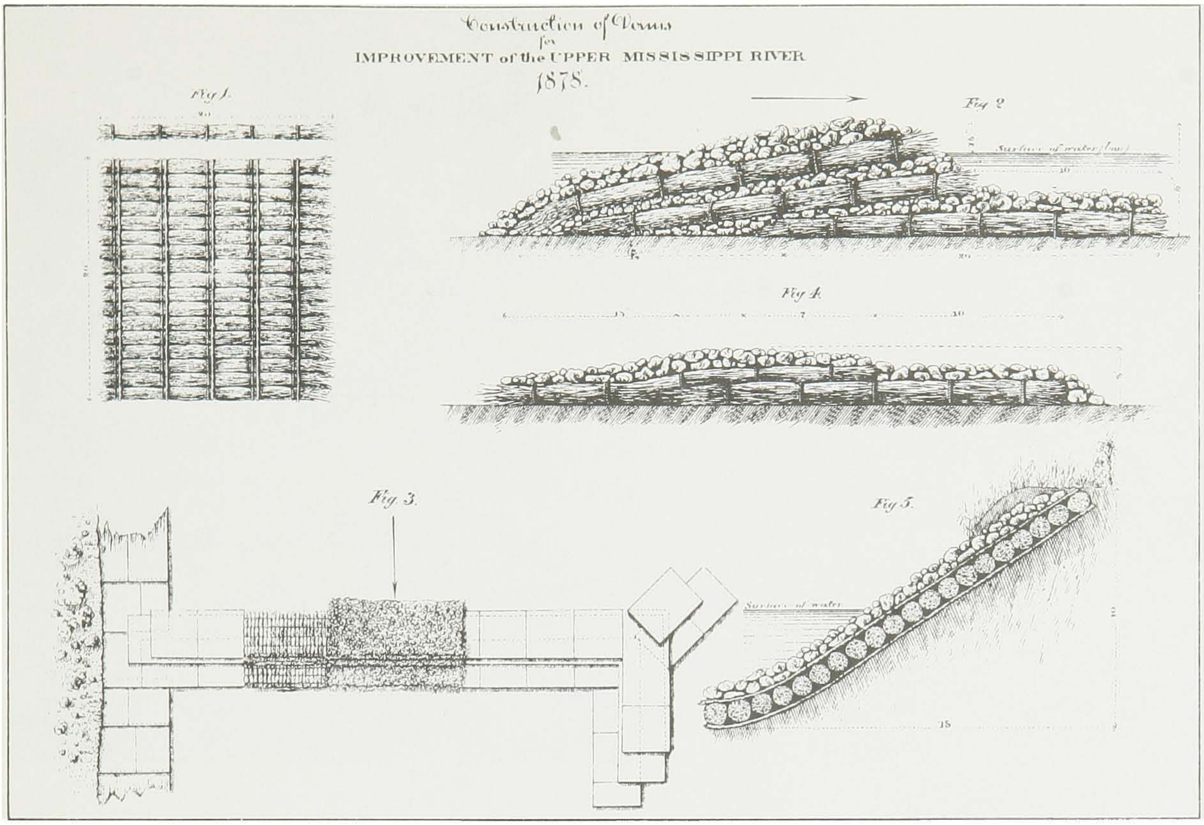



FIG. 16. Sketches of wing dam construction showing the alternate layers of rock and willow mattress. Many of these dams are still solid after nearly one hundred years.

FIG. 17. Sketch of wing dam construction at Pig's Eye Island, the first wing dams built on the Upper Mississippi, showing improvement of the channel resulting from the dams.

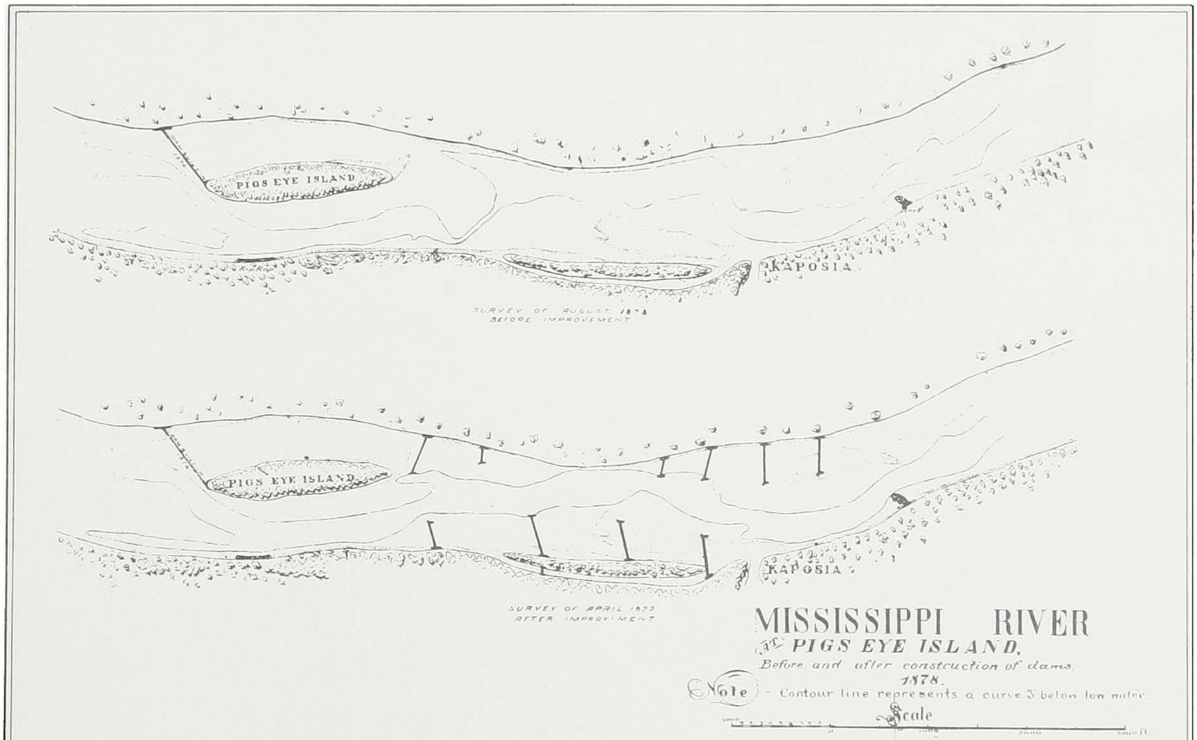


FIG. 18. Each step of wing dam construction involved hard labor, as seen in these photographs of work in the St. Paul area.

—*Minnesota Historical Society*

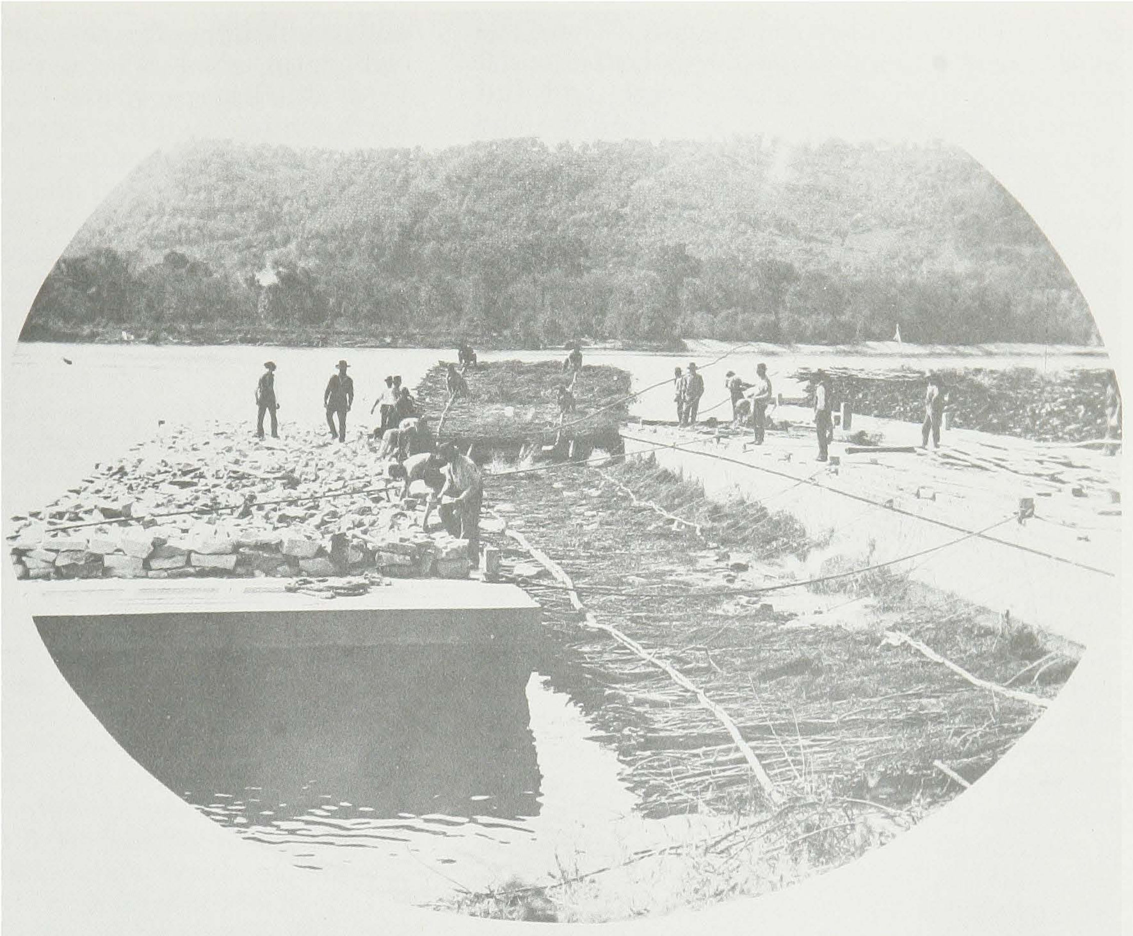


FIG. 19. Unloading rock to sink the willow mattress of a wing dam. Rock had to be loaded and unloaded evenly to avoid tipping the stone barge.

FIG. 20. A row of wing dams at low water, forcing the current into the main channel.

ed 5/7 of the channel width apart. Where the river curved, dams were placed one half channel width apart on the concave side and full channel width on the convex side. The line of the dam pointed upstream 105 to 110 degrees in straight reaches, 100 to 102½ degrees in concave reaches, and from 90 to 100 degrees where the curve was convex. Dams on opposite sides of the river were arranged so that their axes met in midstream.

By 1895 when Colonel Mackenzie left the Rock Island District, 100 miles of wing dams and 94 miles of shore protection had been built on the Upper Mississippi, at a cost of $5,850, 562. By 1895 most of the channel was navigable at low water.

Willow mats were used in the construction of wing dams until 1911. By then it was clear that the supply of available willow was giving out. The Rock Island District had anticipated this and had experimented with willow nurseries and reforesting sandbars with willow cuttings as early as 1881, but the annual floods and rapid currents prevented these from working. In 1911 successful experiments were made using lumber mats instead of willow. They were tried out on the section of the river between the Wisconsin River and Le Claire, Iowa. Following successful experiments here they were frequently used in the lower divisions of the District, between Hannibal and the Missouri River. [12] The cost of lumber mats compared favorably to willow, but they were not as flexible and did not follow the contour of the river bottom as well.

By the time authorization of the 6-foot project put an end to the 4½-foot project, a total of 12,323,067 cubic yards of brush had been put into dams and shore protections. Engineers and contractors had built 336.40 miles of wing and closing dams and 197.30 miles of shore protections. Total cost of the 4½-foot project from 1878 to 1905 was just over $11,000,000.[13]

## OTHER DISTRICT ACTIVITIES, 1877 to 1906

Although the 4½-foot channel constituted the major activity of the Rock Island District during these years, the Corps engaged in many other projects related to navigation improvement. The period was marked by growing commerce and industry in the towns along the shore, and complicated by several major shifts in the pattern of water transportation. It was also a period of increasing responsibility for the Corps of Engineers. In 1894 the Corps was given specific authority to establish and enforce rules and regulations for the use of Government-owned (in other words, navigable) streams. From this has grown the Corps' responsibility for the entire inland waterway system.[14] In 1899 the Refuse Act, Section 13 of the Rivers and Harbor Bill, prohibited discharges except from public street and sewers in liquid form into any navigable water of the United States without a permit from the Corps of Engineers. This Act has been seldom used until the past few years.

The appointment of the Mississippi River Commission in 1879 marked the beginning involvement of the Corps in flood control work. Prior to this, all authorized projects in the Rock Island District were limited strictly to navigation improvement. However, with the exception of several levee repair projects in 1894, District projects during this period continued to be concerned with navigation.

*Harbors*. Harbor improvements in the Rock Island District began as early as 1844 when Engineers began the improvement of the harbor at Dubuque. Appropriations ran out before the work was completed, and several subsequent attempts met a similar fate. Finally, in 1880, Congress appropriated $40,000 for an ice harbor at Dubuque, where boats could winter safe from the effects of the open river. Work was begun in 1882 and completed in 1885. This harbor was used not only by commercial vessels but as winter quarters for a large portion of the District fleet.

Other harbor improvements came slowly. The Corps of Engineers were limited to single-purpose navigation improvement projects. A fine line divided those improvements which were necessary to commercial river traffic and those which primarily aided city interests or private groups of pleasure boaters. Following this guideline, the Corps limited most of its harbor work to dredging sandbars which formed between towns and the main channel, building dams to serve as breakwaters, and deepening the harbors themselves so that larger boats were able to land. Such improvements as harbor enlargement or alteration of shape were left to city or private efforts. By 1911 the District had made major improvements to 22 harbors between St. Paul and Clarksville, including most of the major cities.

In the mid-1880's the Rock Island District designed and constructed two harbors of refuge in Lake Pepin, one at Stockholm in 1885 and one at Lake City in 1887. Lake Pepin is an especially wide-open section of the Mississippi between

Red Wing and Read's Landing. There was no problem with currents for boats crossing the nearly slack water of this section, but the open area allowed winds to build up huge waves. These played havoc with the long log and lumber rafts coming downriver from the northern forests. The rafts were frequently split up by such storms and the logs scattered for miles downriver, creating danger for the packets. At one time the District snagboat *General Barnard* encountered so many of these free logs that she had to lay up for the season.

The two harbors of refuge constructed by the District were designed to provide boats and rafts with a safe harbor from the sudden storms which frequented Lake Pepin. They consisted of long earth and stone piers built perpendicular to the shore which acted as breakwaters.

*Galena River Improvement.* Galena, Illinois was one of the earliest and most ambitious towns on the Upper Mississippi River. Before the Civil War when the lead mines were thriving, more river traffic navigated the Galena River than arrived at St. Paul. But by 1866 when the Rock Island District began, increasing cultivation of the land and a few years of neglect had combined to hasten the natural process of siltation to the point where the Galena River was impossible to navigate in low water and difficult at other times.

A preliminary survey of the Galena River with a view toward improvement was made by Major Farquhar in 1873. Congress authorized an improvement project in 1877, but work did not begin until 1880 when dredging produced a small channel between 35 and 100 feet wide and 4 feet deep, running 5½ miles from the mouth of the river to a point 1½ miles below Galena.

No further appropriations were made. The Galena River project was in that borderline area between a navigable river (which was the Corps' responsibility) and unnavigable rivers (which were under the jurisdiction of state or local authorities). There was doubt as to whether an improvement serving one city would constitute "general" navigation improvement.

Congress finally made a compromise. The Act of September 18, 1890, authorized the City of Galena to improve the Galena River from its mouth to a point 800 feet below the Custom House at Galena. Included in the authorization was a dam not more than 12 feet above low water and a lock not less than 280 by 52 feet. The Act provided that after keeping the river open to a depth of 3 feet or more for one year, the City would receive $100,000 in Federal funds, as partial cost of the improvement.

As a result of this agreement, the Rock Island District assumed control of the Galena Lock and Dam on March 12, 1894. Colonel Mackenzie appointed a lock master and two lock hands. Peak traffic through this lock was reached the following year when 471 boats and barges locked through carrying nearly 5,000 passengers and 2,000 tons of merchandise. By 1896 only 788 passengers on 234 boats passed the lock. The only significant traffic that year consisted of 1,339,000 feet of lumber. The Port of Galena proved to be a victim of the railroad that had bridged the Mississippi at Dubuque, just to the north.

Operation of the Galena Lock and Dam was funded under an indefinite annual appropriation beginning in 1898, but less and less traffic used the lock. In 1918 Congress recommended abandonment of the project. Both the lock and channel had reached a point where extensive repairs and dredging would be needed. Finally, the River and Harbor Act of September 22, 1922 directed that the project be abandoned. The District maintained the channel during 1923, though there had been no traffic of record since 1921. The River and Harbor Act of March 3, 1925, directed removal of the dams in the Galena River. Today, it is hard to imagine that Galena was ever one of the busiest ports on the Upper Mississippi, and that boats of all sizes tied up at her docks.

*Surveys.* Apart from the Galena River survey of 1873 and the preliminary surveys for the Hennepin Canal, the Rock Island District made only two surveys of Mississippi tributaries during this period. Both were authorized by the River and Harbor Act of August 11, 1882, and were to determine if the rivers involved were navigable and worthy of improvement.

The most important of these surveys was that of the Iowa River from its mouth to Wapello, a city of 1,000 where the Burlington, Cedar Rapids and Northern Rail Road crossed the river. Earlier in the century this and other small tributaries had been frequently navigated. Now, Colonel Mackenzie found that small boats still used the Iowa River during the high water season, but that it was not worthy of improvement.

The second survey made in the fall of 1882 was among the most unusual made by the Rock Island District. This was the survey of the Pecatonica River from Argyle to Wayne, Wisconsin. Since April of 1882 a little steamboat called the *Success*, 50 by 14 feet with a 1-foot

draft, had been making semi-weekly trips on this stretch. Even though the *Success* was the only steamer ever to have been on the river, its presence made the stream technically navigable. The Pecatonica was so small that the *Success* had to stop periodically to open gates in the fences farmers had strung across it.

*Bridges.* Railroad and wagon bridges across navigable waters had been the responsibility of the Corps of Engineers since the Act of July 25, 1866. Problems with the Rock Island Bridge in 1856 together with a sudden increase in the number of bridges planned after the Civil War convinced Congress of the need to regulate their construction so as to be fair to both navigation and railroad interests. Congress retained the authority to give or deny permits to build bridges, but the Corps was given responsibility for determining the safest location, the spacing and size of the drawspan and raftspan, and later, when high bridges began to take the place of drawspan bridges, for determining minimum height.

The Act of July 5, 1884, further authorized the Secretary of War to require bridge companies to maintain adequate booms during the navigation season in order to facilitate navigation through the spans. This became a Corps responsibility.

The booms were usually floating chains of logs or lumber cribs extending upstream from the drawspan piers to protect boats from drifting against the bridge. They were kept in place by anchoring them to pilings or to shore. The sheer booms at the Rock Island Bridge were kept in place by a system of rudders using the river current. Bridge companies had to maintain these booms in the channel until November 15 each year. That was when, by tradition, marine insurance ended, marking the official end of the navigation season.

Occasionally, a bridge proved to be such an obstruction to navigation that Congress ordered it altered or removed. Engineers then had the responsibility to see that those orders were carried out. The Hannibal Railroad Bridge which had long been a dangerous annoyance to river traffic, was ordered to modify its structure by the River and Harbor Bill of July 5, 1884. After long litigation and delay, the Hannibal Bridge Company changed the location of its drawspan in accordance with the suggestions of District Engineers.

The Corps of Engineers retained control over bridges across navigable waters until the mid-1960's, when the Coast Guard was assigned that duty.

*Improvements between St. Paul and Minneapolis.* Although the Rock Island District performed little actual improvement on this short stretch of river, District engineers did much of the early planning for later projects.

Among the most important of these was improvement of the Falls of St. Anthony. The upper crust over which the water flowed was composed of hard limestone which resisted wearing. Underneath this thin crust was a layer of sandstone all the way down to the river bed. This sandstone layer wore away much more rapidly than the limestone so that after a time the upper layer would lose its support and break off, moving the Falls a few feet upstream. Erosion was rapid. By 1872 the Falls had moved from 300 to 600 feet above its 1857 location. Left to continue, the Falls would eventually be reduced to a long stretch of rapids, destroying not only the beauty of the Falls, but their potential use for waterpower to a growing industrial town.

In 1872 the Chief of Engineers assigned the improvement of the Falls to Colonel Macomb, who convened a Board of Engineers to study the problem on August 10, 1872.

The natural wearing of the Falls had been hastened in the late 1860's by a private group who began a tunnel at St. Anthony's Falls designed to run upstream for power purposes. The tunnel through the soft sandstone had reached a point under the foot of Nicolet Island late in 1869 when water entered the tunnel, washing a large section out and causing a cave-in. This tunnel further weakened the Falls and the water rushing through tunnel made the situation precarious.

Mr. J.L. Gillespie, Assistant Engineer of the Rock Island District stationed at the District Sub-office in St. Paul, began construction of a wooden apron across Hennepin Island above the Falls to divert the water. The apron was in the process of completion when the work was reassigned to the St. Paul District on July 15, 1878.

During the 1891-92 seasons Colonel Mackenzie supervised the removal of a number of boulders between St. Paul and Minneapolis. The old head of navigation, by act of Congress, had been the steamboat landing below the Washington Avenue Bridge at Minneapolis, but now navigating to that point was hard. Two seasons of removing boulders convinced Colonel Mackenzie that due to the swift current in this stretch, only a slack water system of

locks and dams would bring permanent improvement.

On February 15, 1893, Chief of Engineers Brigadier General Thomas L. Casey ordered Colonel Mackenzie to prepare new and exact estimates for locks and dams between Minneapolis and St. Paul. Surveys and borings were made during the low water of 1893 and the plans and estimates drawn up the following winter. Mackenzie reported that to provide navigation to the Washington Avenue Bridge would require two locks and dams: No. 1 just above Minnehaha Creek and No. 2 at Meeker's Island, 1,000 feet below the C. M. and St. Paul Railway Bridge. The cost estimate was slightly over $1,150,000. Mackenzie reported that to obtain navigation all the way to the flour mills at Minneapolis would require two more locks and dams.[15]

Congress authorized the project for Lock and Dam No. 2 in October, 1894, and a survey was made to locate the exact site. District engineers made plans to lay the lock foundation the following spring. However, a private group who owned rights-of-way on Meeker's Island dragged their feet, and by 1897 when the work in this section of the Mississippi was transferred to the St. Paul District, no work had been done. Lock and Dam No. 2 was not completed until 1930. Lock and Dam No. 1 was opened for traffic in 1915.

*The Moline Lock.* Improvements at the Rock Island Rapids had proved satisfactory while the rest of the channel was unimproved. But by 1900 the remainder of the Upper Mississippi had been improved to the point where the Rapids had again become an obstruction. At the same time, the growing farm equipment industry at Moline pointed up the need for more adequate access to the Moline waterfront. Entry was especially hard for boats coming upstream. The Moline and Duck Creek Chains had steeper slopes and swifter currents than anywhere else on the Rapids. Boats had to cross both of these chains to reach Moline.

The River and Harbor Bill in 1901 contained an appropiation for a survey for a lock at Moline with the understanding that the lock would use the newer method of concrete construction that had been developed for the Hennepin Canal. The bill failed, but passed the following year. A Board of Engineers met in October of 1902 to consider the proposed lock.

Authorization for construction of the Moline lock did not come until the River and Harbor Bill of March 3, 1905. Although the original estimate of cost made in the survey report of 1902 was $386,000, Congress appropriated only $100,000 to begin construction, with the stipulation that total costs would not exceed $286,000.

Major Charles Riche became District Engineer of the Rock Island District in April of 1905 and supervised preparation of designs and drawings for the lock. He was well-prepared for this task, having come to Rock Island from the Second Chicago District where he had supervised construction of the Illinois and Mississippi (Hennepin) Canal. In designing the lock, Major Riche relied on the advice of Meigs and

FIG 21. The U. S. Steam Launch *Emily* becomes the first boat to enter the new Moline lock.

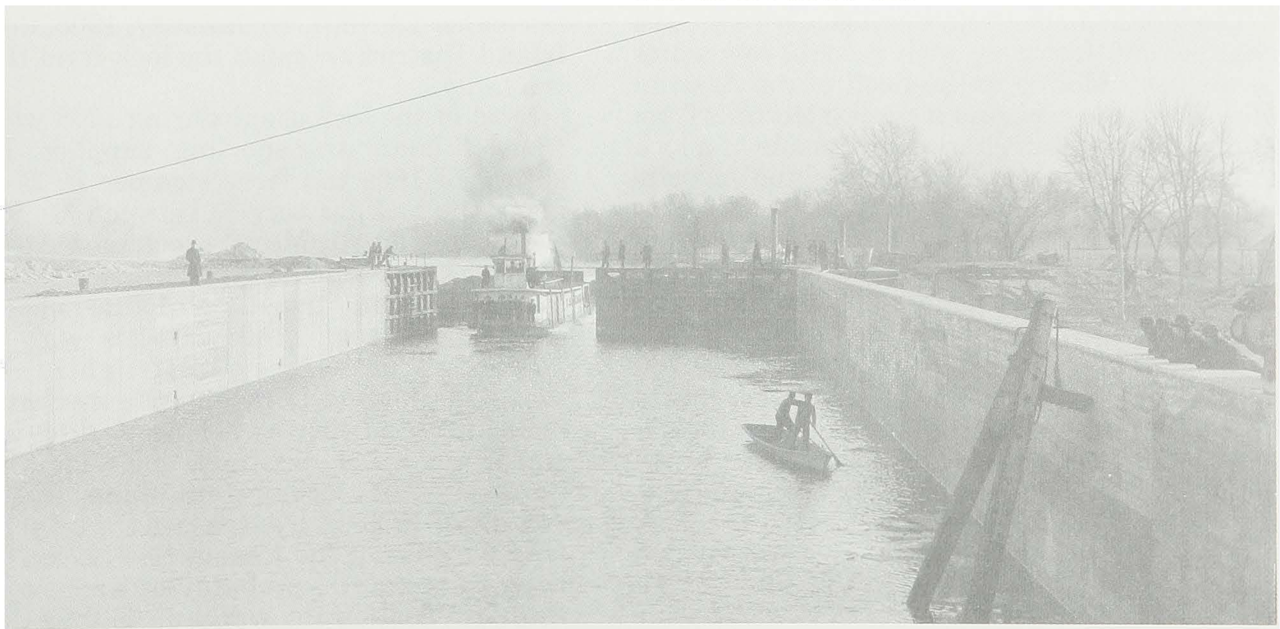


FIG. 22. The Moline lock under construction.

other competent assistant engineers in the Rock Island Office. To supervise construction of the lock, Riche had a Junior Engineer, J.B. Bassett, temporarily transferred from the Northwest Division Office. Mr. Bassett opened a U.S. Engineer Office in Moline. By November, plans were finished.

The Moline Lock Project called for dredging a channel 250 feet wide with a 4-foot low water depth from Moline to the head of the Arsenal dike above the city, and a similar channel from Moline to the main channel by means of a lock and dam at the foot of Benham's Island opposite the city. The Moline Lock was designed to improve 3 miles of the 14-mile Rock Island Rapids.

Bids were advertised and on March 31, 1906, a contract was signed with the Dravo Contracting Company of Pittsburgh, to be completed on or before April 1, 1908. The lock chamber was to be 325 by 80 feet. Original plans called for a 4-foot channel depth with 5 feet in the locks, but in September of 1905, anticipating the coming 6-foot project, the depth was increased to 6 feet. The lock was to have concrete walls and wooden gates, operated by electricity. The dam and all back fill were to be built by the Corps using hired labor.

Work went smoothly on all aspects of construction, except for a stray shot now and then from the Arsenal test range. Though not completely finished, the lock opened for traffic on December 23, 1907. In January, 1908, the Rock Island District accepted the lock from the contractor.

Most of the lock usage during 1908 was from District boats transporting supplies. In the spring of 1909 the ferry steamer *B. B.* began using the lock for service between Moline and Bettendorf, and by May the lockmaster recorded 612 lockages with 17,308 passengers. Only three months later, in August, the Moline Lock recorded its peak use: 1,140 lockages with 18,998 passengers, but a commercial freight of only 182 tons. The Moline Lock had the misfortune of being finished just as a long decline in river traffic set in. It did have one year of glory, however. The lockages in June, July, and August of 1909 each surpassed the total for any single month of the famous Soo Locks. In fact, these three months probably set a record greater than any lock in the world up to that time.[16]

## FOOTNOTES

Chapter IV

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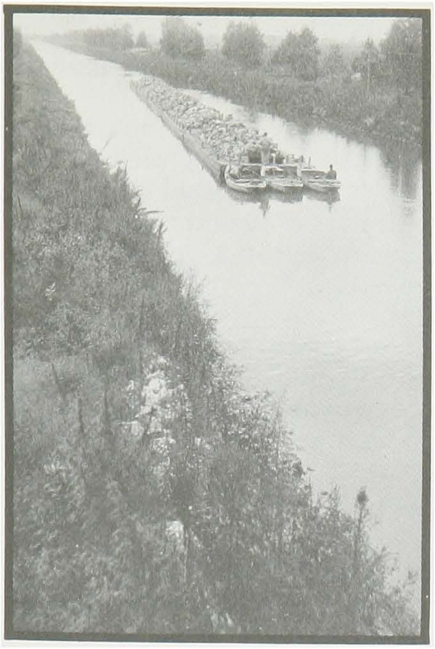
2. *Official Report of the Proceedings of the Mississippi River Improvement Convention Held at St. Louis, Mo., 1881* (St. Louis: Great Western Printing Co., 1881), p. 107.
3. Material here and on the next three pages is from the *Annual Reports* of 1878-79.
4. J. D. DuShane to Col. W. R. King, August 22, 1895, File 1653, Vol. 43, Press Copies of Letters Sent ("General Letter Books"), RG 77, NA.
5. *Annual Report*, 1875, p. 38.
6. *Annual Report*, 1876, Appendix T, p. 6.
7. *Annual Report*, 1880, II, p. 1493.
8. *Annual Report*, 1881, II, p. 1679.
9. Alberta Hill, "Out with the Fleet on the Upper Mississippi, 1898-1917," *Minnesota History* (September 1961), p. 285.
10. *Ibid.*
11. *Ibid.*, p. 287.
12. Samuel Edwards and Robert Iakisch, "Uses of Plank or Lumber Apron for Shore Protection on the Upper Mississippi River between the Wisconsin River and Le Claire, Iowa," *Professional Memoirs*, VII (1916), p. 390.
13. C. W. Durham, "Project and Estimate for Slack Water Navigation, 6′ at Low Water, from St. Paul to Missouri River," Rock Island, Illinois, June 27, 1906. Rock Island District Historical Files.
14. Smith, p. 80.
15. Colonel Alexander Mackenzie to Chief of Engineers, March 1, 1894, File 1652, Vol. 3, Press Copies of Letters Sent ("General Letter Books"), RG 77, NA.
16. *Annual Report*, 1909, II, p. 1636.



CHAPTER V

# THE ILLINOIS AND MISSISSIPPI CANAL

As the new towns of Rock Island, Davenport, Burlington, and Dubuque looked to similar towns in the East in the 1830's, they saw what power the canals then being built had to transform villages into industrial cities. They were also aware of how close the Illinois, Rock and Wisconsin Rivers came to connecting with Lake Michigan and the Great Lakes traffic. It was natural that commercial interests in these towns should push Congress to consider canals between these rivers and the lakes.

A decade later they saw visible proof of the power of the canal close at hand. In 1845 Chicago had a population of 12,088; when the Illinois and Michigan Canal was completed in 1848, connecting Lake Michigan at Chicago with the Illinois River, the population grew to nearly 20,000 as the Canal brought new commerce in grain, cattle, and hogs.

There was every reason to believe a connection with the Lakes might do the same thing for the Mississippi Valley. Consequently, steady pressure for such an improvement developed and remained strong. Congress authorized surveys of the Rock and Wisconsin Rivers in 1866, but both these rivers presented too many problems. Pressure then grew for a canal to connect with the Illinois and Michigan Canal. In its planning stage this came to be known as the Hennepin Canal. To increase the national image of the canal and decrease its local connotations, the name was changed in 1888 to the Illinois and Mississippi Canal.

Unfortunately, by the time the canal was finally authorized and built the day of the canal was long over. The Illinois and Mississippi Canal never came close to reaching the expectations of its proponents. It was a case of too little, too late.

The first recorded interest in a canal between Hennepin, on the Illinois River, and Rock Island came in 1834 at a meeting called at the Court House in Hennepin by a local citizen Augustus G. Longworthy.[1] At that meeting a Mr. Joseph Galer of Geneseo, Illinois, reported on a personal survey he had made:

> In September, 1834, I took my blanket and gun and viewed the country through from Hennepin to the Mississippi River near Rock Island and thought it a natural pass for a canal as there was a depression all the way across with high land on either side. I reported my discovery but was much ridiculed for holding such ideas.[2]

During the Civil War the need for such a route increased. England was none too friendly toward the North and her control of access to the Great Lakes by construction of the St. Lawrence and Welland Canals caused concern.

On January 19, 1864, a meeting was held in Davenport, Iowa, of those interested in a water

route to the East. A committee was appointed to secure an appropriation from the Iowa Legislature for a survey.[3] Another survey was called for in 1866 by the Geneseo Canal Convention. But the first survey made of the route was made by a civil engineer, J.O. Hudnutt, from subscriptions taken up by citizens of Dixon, Illinois.[4] Mr. Hudnutt estimated that a 60-foot channel with a 6-foot depth running 70 miles from Hennepin on the Illinois River to Watertown in the Mississippi, with a feeder to Dixon, woulc cosn $4,500,000.

On July 23, 1870, Colonel Wilson was ordered to make the first Federal survey for a canal from Hennepin to the Mississippi generally following the lines laid down by Mr. Hudnutt. $12,000 was appropriated. Civil engineer Gordon P. Low began this survey at Henry, Illinois, on September 5. Low's report contained plans for a canal 160 feet wide and 7 feet deep with 350 by 75-foot locks, at an estimated cost of $12,500,000. Congress authorized a survey for a route all the way to Lake Michigan in 1874. This was to include a canal between the Illinois and Mississippi Rivers. District engineers completed only the Illinois and Michigan Canal portions of the survey, adopting the 1870 Low survey for the rest of the route.

Nothing came of these early surveys. During the next few years canal conventions were held throughout the area to lobby for canal authorization. 900 people attended a convention at Rock Island on March 24, 1874. A similar convention at Rock Island a year later appointed delegates to lobby in Washington. Other conventions were held at Ottawa, Illinois, in 1879 and at Davenport in 1881. This latter convention appointed a Hennepin Canal Commission which met at Chicago with groups from throughout the Midwest. The Commission created publicity stressing the national character of the project, and got the Buffalo, New York, Board of Trade to pass a resolution in favor of the canal.

A canal bill came before Congress in 1882. An original bill sponsored by the New York Board of Trade called for an appropriation of $1,000,000, but this was killed by St. Louis interests who opposed the canal. The bill which passed appropriated $30,000 for another canal survey.

This survey was carried out in 1882 by Major W.H.H. Benyaurd of the Chicago District. From this point on the planning and construction of the canal came under supervision of the Second Chicago District. The completed canal was transferred to the Rock Island District in 1911, when the Second Chicago District was dissolved.

Major Benyaurd's survey report submitted on March 31, 1883, recommended three possible routes from the feeder canal northwest of Sheffield; the Marais d' Osier, the Watertown, and the Rock Island. Again, Congress took no action on this report.

In 1882 the State of Illinois ceded the Illinois and Michigan Canal to the United States with the condition that the 97-mile canal from La Salle to Chicago be enlarged and maintained as a national commercial waterway. The success of any canal to the west was dependent on improvement of the Illinois and Michigan Canal.

During the next three years the canal project was supported by a resolution passed by the New York Legislature and by the Knights of Labor. In 1886 Congress appointed a Board of Engineers to examine routes and investigate the effect on commerce of a canal. The Board reported that benefits would exceed costs. Their investigation showed the Marais d' Osier route to be the most feasible. The Marais d' Osier ("willow marsh") was a naturally low area connecting the Rock and Mississippi Rivers upstream from Rock Island. During high water seasons on the Rock and Mississippi Rivers the Marais d' Osier (now called Meredosia) flooded to a depth which permitted steamboats going between the two rivers to bypass Rock Island. This route had no rock to go through, a soil easy to work, and half as many bridges as the Rock Island route. But the Board chose the Rock Island Route because of its "greater military significance"[5] and because of commercial advantages.

Detailed plans and estimates for the Illinois and Mississippi Canal were presented to Congress in 1888. The plans by Capt. W.L. Marshall routed the canal from the great bend of the Illinois River 1.75 miles above the town of Hennepin, via Bureau Creek Valley, Penny Slough, and the Rock River to the Mississippi at the mouth of the Rock River, with a feeder from the canal north to the Rock River near Dixon, Illinois. Captain Marshall estimated the cost at $6,925,960.[6] The previous distance by water between Chicago and Rock Island (via the Illinois River) was 607 miles. The new canal would reduce that to 188 miles.

The River and Harbor Bill in 1890 provided $500,000 for the canal project, but limited expenditures to buying right of way and to construc-

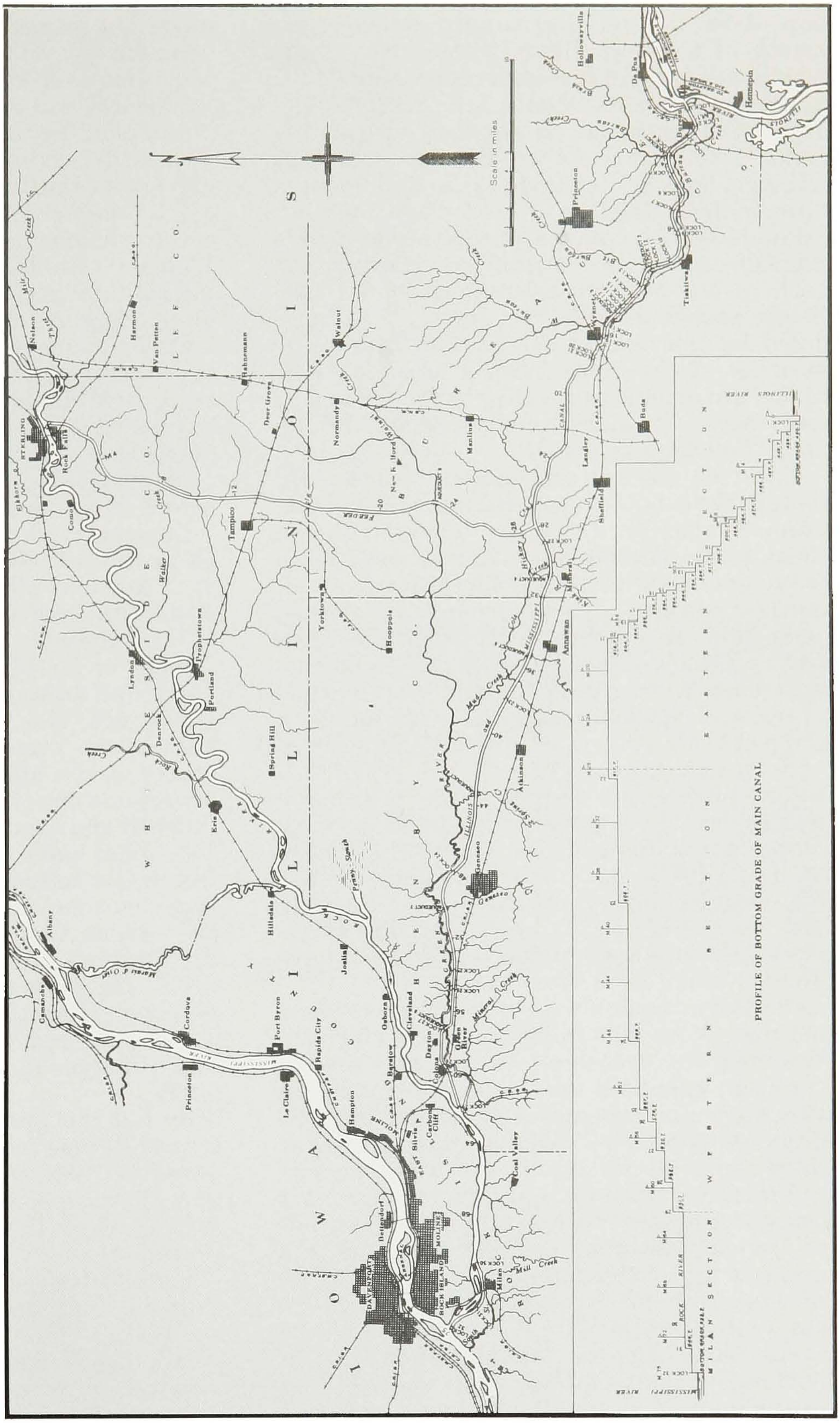



FIG. 23 Map of the 67-mile Illinois and Mississippi Canal joining Bureau, on the Illinois River, with Rock Island, on the Mississippi.

tion of the five miles of canal just above the mouth of the Rock River, where most of the population was. In November Marshall (now a major) and his assistants L.L. Wheeler and James C. Long began the work of locating the canal. One immediate problem was that the Chicago, Rock Island, and Pacific Railroad was already there and had taken the best route.[7]

Land for the canal as acquired as it was needed: the Milan section in 1891-92, the Eastern and Western sections in 1893-98, the Feeder section in 1896-1901, and the land inundated by the dam at Sterling in 1905-6. The majority of the land, 3,824.94 acres, was obtained under fee simple title, and the remaining 1,449 acres (for Lake Sinnissippi at Sterling) under flowage easements.

Marshall, Wheeler, and Long located the final route of the canal to begin just above Hennepin. From here it ran along the valley of Bureau Creek to the summit level 18 miles west. From the summit it went to the Rock River just above the mouth of Green River, then followed the bed of the Rock River to the rapids near Milan. Here it left the stream and arrived at the Mississippi at the mouth of the Rock River, a total length of 75 miles. The feeder extended from the Rock River at Rock Falls to a point 29.3 miles south, where it met the main line.

For construction purposes the canal was divided into five sections: Eastern, Western, Feeder, Rock River Pool, and Milan. James Long had local charge of the Eastern Section; L.L. Wheeler supervised the Feeder, Western, and Milan sections; and the Rock Island District supervised the improvement of the natural channel of the Rock River Pool.

The Milan section was to contain two dams and three locks. The traditional facing for such structures was cut stone, but recently several European countries had begun to experiment with artificial stone made of cement. In 1891 Major Marshall requested that the structures at Milan be used to experiment with concrete construction because it appeared to be stronger and more durable, and less than half the price of cut stone. Marshall pointed out that the economy of concrete would permit a 5-foot increase in the width of the locks. Permission was granted on May 11, 1891, with the locks increased to 35 feet. This pioneering use of Portland cement by Marshall and Wheeler revolutionized the construction industry and set a new pattern for canal construction, especially at the Panama Canal project. Innovations in construction included not only the use of cement, but in methods of application. The concrete for the arch culverts was mixed by hand according to existing practice. But the concrete for the lock walls was mixed by machinery and put in place by workmen working three shifts a day until each wall was complete.

Work began on the Milan section in July, 1892. L.L. Wheeler turned the first sod with a spade which is now in the Davenport Museum. Wheeler established an Engineer Office in Milan to supervise both contract and hired work. The earthwork and lock foundations were built under contract, while most of the lock superstructures, including those at Milan, were built with hired labor. The earthwork was completed in lots of 4 miles each, with each mile going to the lowest bidder for that mile. The earthwork along the whole canal was done long before the gates and locks.

Contract work for the Milan section had been let in June of 1892, but on August 1 the 8-hour work law took effect, materially increasing the costs. The Chief of Engineers directed Marshall to rebid the contracts.

Work in the Milan section consisted of four and a half miles of canal trunk, two dams, one guard lock, two lift locks, one railway drawbridge, one wagon drawbridge, one pontoon bridge, seven sluices, one culvert, three lock houses and one office building. This section was finished and opened to traffic on April 17, 1895. The Canal had a 7-foot depth and a width of 52 feet at the bottom of the cut and 80 feet at the water surface. At the opening celebration for this section Captain W.C. Clark, a river pilot from Buffalo, Iowa, prophesied that the Canal would not come to much. Not all of this was prophesy; Capt. Clark pointed out that the Canal was already too small for the new generation of barges then being constructed for river traffic.

By fall the first coal from the coal fields of central Illinois was coming down the Canal. On March 30, 1901, the Milan section of the Illinois and Mississippi Canal was transferred to the Rock Island District for maintenance and operation.

The Eastern section of the Canal proved to be the most challenging. This section of 24 miles to the feeder at the summit rose 196 feet above the Illinois River and required 21 locks with lifts varying between six and twelve feet. Also, because of proximity to Bureau Creek, which had to be crossed by three aqueducts, an especially high embankment was necessary. Between mile 20 and 23 a peat bog was un-

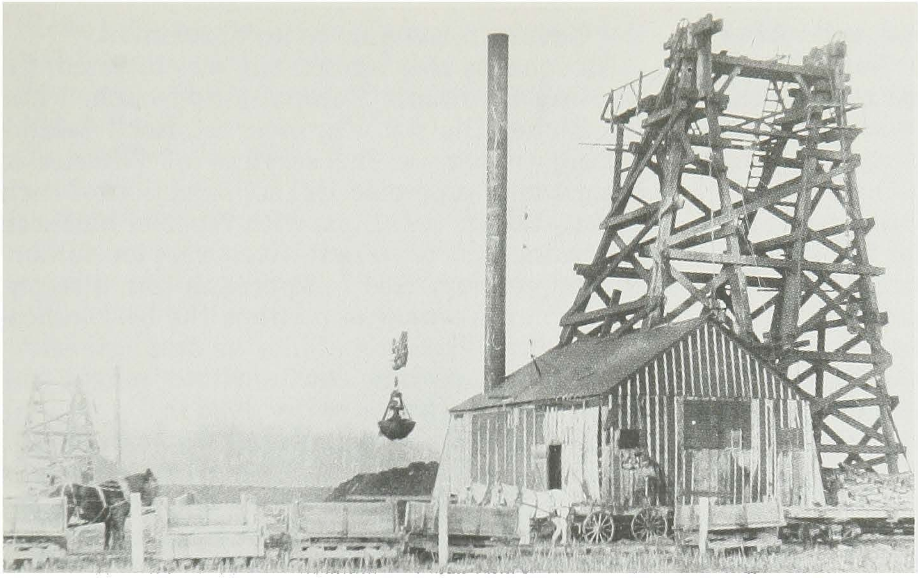


FIG. 24. Excavation by overhead cableway, a necessity along some parts of the Canal due to soft, peaty ground.

FIG. 25. A lock foundation on the Canal.

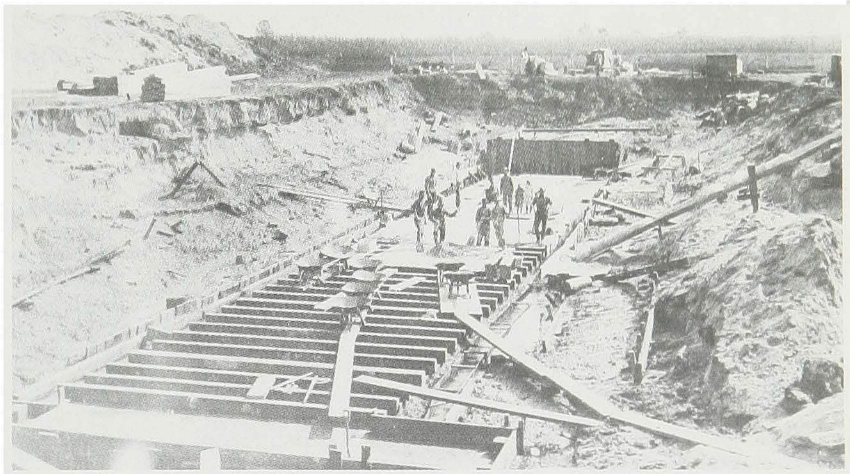
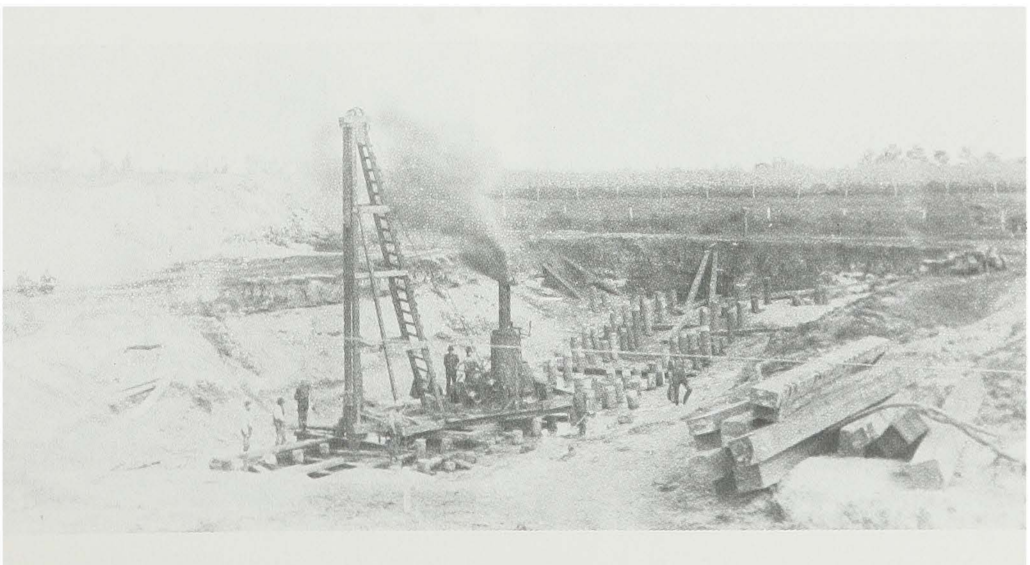


FIG. 26. Machinery excavating a lock foundation.



covered beneath apparently good soil. After numerous problems with this soft, soggy ground, District engineers had to excavate the section by overhead cableways stretched between wooden towers 500 feet apart, using hired labor. (See photo on page 155.)

The Feeder section provided problems of a different sort. Work began on the feeder after completion of the Milan section, with L.L. Wheeler in charge. Both Dixon and Sterling wanted the head of the feeder located in their city limits for commercial reasons. Dixon had been the original site, but private citizens at Sterling raised money for a survey of their own. They presented this survey to the Secretary of War together with profiles and estimates, and they won. There were advantages to locating the feeder at Sterling. It made the canal shorter by 5.7 miles, did away with the need for a lift lock, needed one less pivot railway bridge, and provided better control of flood heights.

As soon as the decision to locate the canal feeder at Sterling was made, problems arose with the Sterling Hydraulic Company, a private power concern with a State charter, over use of the limited water of the Rock River, and the design of the Government dam. Litigation continued for several years and was the subject of numerous reports. L.L. Wheeler, who had moved his office to Sterling to superintend construction of the feeder, was caught in the middle of the fight. During most of the struggle the power company interests would not even speak to him. Finally, on December 6, 1906, the company and the Government came to an agreement.

As soon as this agreement was effected, the Sterling Hydraulic Company approached Major Riche, District Engineer at Rock Island, asking to borrow the services of Wheeler to design and supervise the construction of their power station. Relations with Wheeler had been so strained the representatives were too ashamed and embarrassed to approach him directly. This compliment was perhaps the best indication of Mr. Wheeler's ability as an engineer.[8]

Other complaints continued to plague the canal project. Drainage involved in digging the canal had lowered the ground water in places. Farmers were able to plant on ground that was previously too swampy. When operation of the canal brought the water table back up this low ground returned to its original wet state. Even though the situation was not as bad as it had been before the canal was built, the Corps of Engineers came in for a great deal of criticism for flooding fields.

People who pushed so long and so hard for the canal before it was built seemed to have disappeared. In a letter to General Mackenzie (now Chief of Engineers), Major Riche complained:

> The canal work has been almost constantly annoyed by exhorbitant claims of all kinds. It has been carried out thru a population almost hostile, so far as facilitating the work was concerned. The customary course seems to have been to "hold up" the Government as far as possible. It is not improbable that the Secretary of War and his subordinate officers and employees may be enjoined from putting water in the canal after its completion.[9]

FIG. 27. Lower gate of Lock 2 at Bureau, typical of construction on the Hennepin Canal.

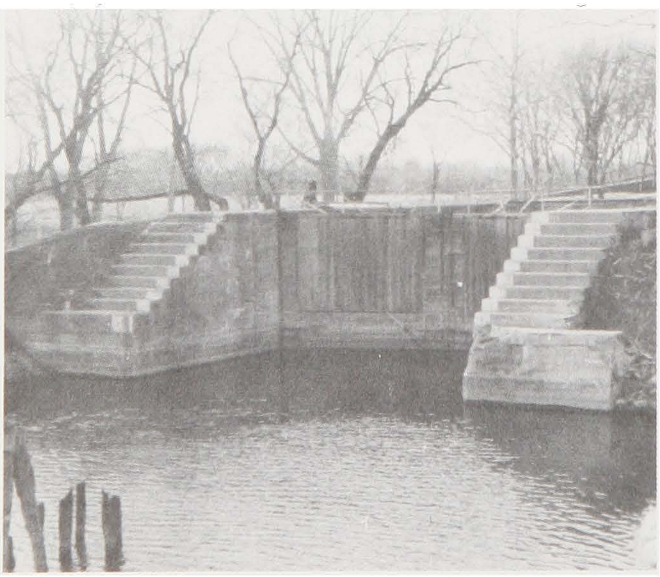


FIG. 28. Upper gate of Lock 2.

Riche later requested watchmen to protect the canal from vandals who had ceased annoying railroads in order to devote their entire attention to the canal.[10]

On October 11, 1907, water was turned into the completed canal for testing. Engineers were afraid that the embankments, having been dry for so many years, might develop cracks. But all went smoothly and on November 15, Major Riche reported the arrival of the United States Steamer *Marion* after having passed through the entire line of the canal using steel guards to break the thin layer of ice.

The Canal worked well from the beginning. After sediment had seeped into the minor cracks and stopped leakage, the whole canal operation required only one cubic foot per mile per second to make up for evaporation, waste, lockages, and leaks.

The completed canal contained 33 concrete locks with lock chambers 35 by 170 feet and walls 240 feet long and a top width of 4 feet. Ordinary mitre gates placed at an angle of 70°30′ from the center line of the lock were used for all lower gates and for all but 14 upper gates. The remaining 14 were fitted with automatic gates with air chambers designed by Major Marshall. The locks, walls, piers and aqueducts used 240,000 cubic yards of concrete.

Locks were filled by two tunnels, one around each of the mitre walls. A butterfly valve at the head of each tunnel was operated from the top of the wall by means of a hand wheel. There were similar valves for emptying the locks at the lower end.

Construction of the Canal required nine aqueducts at places where the canal crossed waterways. These were of reinforced concrete from four to ten spans of 35 feet each. Many bridges also had to be constructed by the Engineers. The Canal was crossed by four different branches of the Chicago, Burlington and Quincy Railroad; by the main line of the Chicago, Rock Island, and Pacific Railroad at three points; and once each by the Rock Island and Peoria Railroad, and the Peoria Branch of the Chicago and Northwestern Railroad. In addition to several pontoon bridges at farm crossings, the Corps built 67 highway bridges, most of which were the fixed type with a 12-foot clearance.

Total cost of the Canal and related structures to June 30, 1908, was $7,319,563.39.

The Canal was operated by dividing it into sections of four to twelve miles each, under an overseer. Each overseer had lockmen and patrolmen under him, and in summer a hired labor force. To provide housing for these men the Corps built houses, barns, and equipment shed adjacent to the Canal. A telephone system was also installed.

Major Marshall who was in charge of the Canal when construction began, remained in charge until December 31, 1899, when Major J.H. Willard assumed charge. Major Willard remained in charge until July 31, 1903, when the project was assigned to Major Riche. On April 20, 1905, Major Riche turned the work over to Major W.H. Bixby. Colonel Bixby retained charge until April 30, 1906, when he turned the work back to Major Riche. At the time, Major Riche had been District Engineer of the Rock Island District since 1905. Major Riche remained as District Engineer of both the Rock Island District and the Second Chicago District. The duties of both offices were carried out primarily from Rock Island, although the Second Chicago District also retained a Chicago Office. On February 18, 1911, the Second Chicago District was dissolved and the operation and maintenance of the Illinois and Mississippi Canal was transferred to the Rock Island District.

Usage of the Canal was disappointing from the start. Event after event seemed to conspire against the project. When the canal was begun Rock Island had been the prime coaling station on the Mississippi River. Shipments of coal to Rock Island alone could have kept the canal busy. But within months of the opening, the coal fields in central Illinois closed. The Morton Salt Company of Chicago projected making large shipments to the Mississippi, but the deteriorating conditions of the Illinois and Michigan Canal stopped that. Two grain elevators were built along the Canal in 1910, but the potential grain business never developed. In addition, the Canal opened just as a decline of river transportation everywhere had set in. Finally, in 1933, the State of Illinois and the Federal government completed the Illinois River project from Utica to Lockport, with the same 600 by 110-foot locks as on the Mississippi. New barges were designed for this river traffic, not for the Canal.

Until 1933 the average yearly tonnage moved on the Canal was 10,000 tons. During that peak year 30,000 tons was moved, or 1/600 of the maximum planned capacity.

The Canal was always used as much for recreation as commerce. In 1911 the Rock Island YMCA was given permission to hold swimming

FIG. 29. The Hennepin Canal shortly after completion.

FIG. 30. The Hennepin Canal today is a recreation spot, awaiting status as a state park.

classes in the Milan section. Fishing and picnicking became common as the Rock Island District attempted to make the Canal pleasant for area residents. The bare canal banks were planted with trees. In 1914 the District planted three bushels of catalpa seeds and nine bushels of elm in nine nurseries, and transplanted 560 walnut trees along the canal banks. During the 1920's and 30's the District sold ice cutting rights on the Canal for $43 per acre.

A brief chance at a new life for the Illinois and Mississippi Canal came with the River and Harbor Act of July 3, 1930, which provided for an examination and survey for a 9-foot channel from Janesville, Wisconsin, on the Rock River to the head of the Canal feeder, then down the feeder to the Canal, and from there to Rock Island. A preliminary report was filed the following year, but the final report submitted in 1939 was unfavorable.

The Canal experienced two periods of very depressed traffic in 1932-36 and 1946-51. By 1946 the Canal had deteriorated badly. During World War II International Harvester had used the Canal to ship steel products from its plant on the Calumet River to its plant at Rock Island, but this operation ceased when the War ended. Operation of the Canal was severely reduced in 1948 to conserve the limited funds appropriated. It was kept open for all types of navigation on Thursdays and Fridays each week with prior arrangements made one day in advance. Commercial tows were permitted to go on other days with 7 days' notice.

By 1950, however, the condition of the Canal had so deteriorated that only 3.5 feet of water remained in the Rock River section, and 4 feet in the Feeder section, restricting the use to pleasure craft and lightly loaded barges. On June 30, 1951, the Illinois and Mississippi Canal was closed to traffic.

District engineers considered several methods of disposing of the Canal. They estimated that draining and abandoning the Canal would cost $1,700,000, while putting the Canal property back to its original state would cost in excess of $10,000,000. One possibility was the use of the property as a National or State Park. The Canal was historically important as the last long stretch of canal in the United States, and it was ideally suited for boating and bicycling.

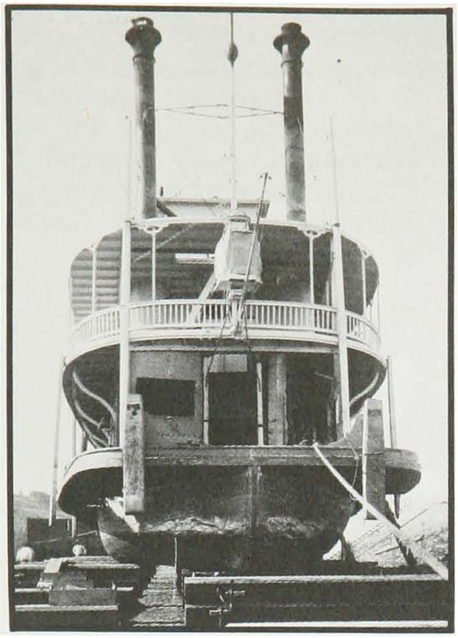
In 1953 the Illinois Legislature created a legislative Commission of 13 members, known as the Illinois and Mississippi Canal and Sinnissippi Lake Commission. This Commission, reappointed every two years between 1953 and 1963, was to study possible recreational uses for the Canal.

During 1961 the Corps of Engineers began modifications on the Canal to rehabilitate it for recreation. The old gates were removed and replaced by concrete headwalls to maintain a 5-foot channel. On August 1, 1970, the Illinois and Mississippi Canal was turned over to the State of Illinois. Its ¼-mile by 75-mile strip serves today as a most unique recreation area.

FOOTNOTES

Chapter V

1. L. L. Wheeler, "Construction and Operation of Illinois and Mississippi Canal, Lock at Rock Falls, and Movable Dam" (unpublished paper for Second Lieutenants who visited Sterling, Rock Island, Illinois, September 29, 1911), p. 1.
2. Joseph Galer, Geneseo *Republic*, March 6, 1884, p. 1.
3. Clifford Stephens, *A History of Rock Island and Rock Island Arsenal from Earliest Times to 1954*, Vol. 1 (Rock Island U.S. Army Rock Island Arsenal, n. d.), p. 123.
4. *Annual Report*, 1883, p. 1755.
5. John Steinbach, "History of the Illinois and Mississippi Canal" (unpublished Master's thesis, Illinois State University, 1964), p. 26.
6. U.S., Congress, House, *Illinois and Mississippi Canal*, Executive Doc. 429, 51st Congress, 1st Session, 1890, p. 2.
7. Steinbach, p. 26.
8. Major C. Riche to Chief of Engineers, August 13, 1907, Letters Sent, Chicago District, Rock Island District Historical Files.
9. Major Riche to Chief of Engineers, August 13, 1907, Letters Sent, Chicago District, Rock Island District Historical Files.
10. Major Riche to Chief of Engineers, January 2, 1908, Letters Sent, Chicago District, Rock Island District Historical Files.



CHAPTER VI

# THE ROCK ISLAND DISTRICT FLEET

Although much of the improvement work supervised by the Corps of Engineers on the Upper Mississippi River was done by contract, as Congress wished, the experimental nature of the early work demanded close supervision by the Corps, as well as frequent construction by the use of hired labor. Then, too, until the work of improvement was well under way contractors lacked the equipment required by the many different kinds of improvement. In 1879, for example, when the 4½-foot channel project began, there were only four privately-owned dredges on the Upper Mississippi. Contractors were not about to invest in specialized and expensive equipment until it became clear that Congress was serious about navigation improvement. Finally, most of the early contractors with enough experience to bid on river navigation projects were Eastern firms who had difficulty moving equipment so far.

The result was a Corps boat fleet. As the number and complexity of projects on the Upper River expanded, the Rock Island District gradually developed an extensive fleet of boats in all shapes and sizes: towboats, tenders, snagboats, dipper and hydraulic dredges, quarterboats, buildingboats, barges, launches and skiffs. To service this fleet the District, under prodding by Montgomery Meigs, established a dry dock and machine shop along the Des Moines Rapids Canal at Keokuk in 1883. This was followed by three more boatyards between 1895 and 1908: one at Fountain City, one at South Stillwater, and the Silver Lake Boatyard at Milan.

Rock Island District boats were not only repaired and wintered at these yards; many boats designed by Meigs and other engineers were built here. At the peak of their activity from 1890 to 1910, work at these boatyards far outstripped the output of any other Engineer district in the United States, building, rebuilding, and servicing a Rock Island District fleet of more than 200 boats.[1]

With the coming of the 9-foot channel, done mostly by contract work, the need for such an extensive fleet disappeared. As the limits of the Rock Island District contracted, boats were transferred to the St. Louis and St. Paul Districts. The last of the large boats, the "million dollar dredge" *Rock Island* was transferred out of the District in 1958. Today the District maintains a modest fleet of towboats and workboats, but the hiss of the steam engine and the slap-slap of the paddles are long gone.

The first steamboats in the Rock Island

District were the *Montana* and the *Caffrey* bought by Major Warren in St. Louis in 1867. Warren had purchased a quarterboat and several small skiffs for his survey crews in the fall of 1866, but these were moved from place to place by rented boats or commercial packets. Colonel Wilson at the Des Moines and Rock Island Rapids had been given no appropriations for boats at all. Major Warren requested an appropriation for Wilson to buy boats, claiming that the Rapids work was suffering for lack of transportation.[2] But finally Warren lent his own boats to the Rock Island Rapids project. The Des Moines Rapids work had one small canal boat drawn by horses. Meanwhile, Colonel Wilson's assistants Lieutenant Charles Allen and E.F. Hoffmann moved from place to place by obtaining free passes on commercial packets.[3]

The *Montana* had been built for the Missouri River trade and the *Caffrey* for the Tennessee River. Both boats required extensive modification to suit them for their Upper Mississippi snagging operation. The work was performed at the dock yards of the N.W.U. Packet Company at La Crosse, Wisconsin, and at St. Paul. The boats had their forward guards removed, and the boiler and hurricane decks reduced. In addition, the *Caffrey* had its Texas deck and the superfluous parts of the cabin removed. Both boats were fitted with Long's Scraper for dredging, and the *Montana* was also fitted with swinging cranes of 15 tons lifting power each for snag removal. As a pilot for the *Montana*, Warren hired David Tipton, one of the most respected men on the River. David Tipton had begun as a keelboatman; he continued in the service of the Rock Island District until he dropped dead at the wheel of his boat in 1904 at the age of 84.[4] The last of the District snagboats was named the *Tipton* in his honor after he died.

Warren was able to operate the *Montana* and Caffrey very economically. The total cost for wages, fuel, and food came to about $100 per day per boat. The cost of operating a commercial packet on the Upper Mississippi River during the same period ran between $350 and $650 per day.

In 1868 Warren bought a small raftboat, the *Winneconne*, for the Wisconsin River improvement. The boat cost $8,500 and was well built for snag operations because of her rafting equipment. Low water in 1868 prevented her from working on the Wisconsin in 1868. During the 1869 season she was employed cleaning out snags between Portage and Sauk City, but her draft was troublesome on the shallow river. Warren recommended cutting the boat in two and lengthening the hull to decrease the draft.

When Major Warren left his duties on the Upper Mississippi, the boats he had assembled were transferred to Colonel Macomb.

In 1877 Colonel Macomb received authority to buy a dredge for the Des Moines Rapids Canal work. This boat was the dipper dredge *Ajax*, built at Quincy, Illinois, in 1876 by H.S. Brown, for which Macomb paid $11,500. The *Ajax* was a medium boat 73 feet long with a 26-foot beam and a 3-foot, 5-inch draft. The steam hoisting engine operated a 1½ cubic yard dipper at the end of a 30-foot boom. The *Ajax* served as the Canal dredge until after World War I.

Also in 1877 Colonel Macomb bought a small steam launch the *Iris* for $350 to use in the improvement of the Burlington harbor.[5]

The first boats designed for the District were built the following year, in 1878, when Major Farquhar improvised two steam drill scows in an attempt to improve rock excavation at the Des Moines and Rock Island Rapids. These have been described earlier. The drilling scows at the Des Moines Rapids were used in the channel between Nashville and Montrose. (See illustration on page 176.)

During the fall and winter of 1878-79 the worn-out machinery and deck of the *Montana* were put into a new hull by D.S. Barmore at Jeffersonville, Indiana, home of several early shipbuilding firms. The new boat was named the *General Barnard* in honor of the man who had been Chief Engineer of the defenses of Washington and Chief Engineer of the Armies in the Field under Grant during the Civil War. General Barnard had refused a nomination from President Lincoln to become Chief of Engineers following Totten's death. In 1878 General Barnard had been appointed to the Board on Improvement of the Low-water Navigation of the Mississippi and Missouri Rivers.[6] The *Barnard* arrived in Rock Island on April 24, 1879.

The practice of rebuilding worn-out boats into new ones with new names was a common practice on the Mississippi where machinery was expensive and the hulls subject to frequent wrecks and the natural effects of being in water and ice. When the *General Barnard* was condemned in 1900, however, it was replaced by an entirely new boat, the *Colonel A. Mackenzie*. Only the dishes and a few items of furniture from the *Barnard* went with the new boat. The *Mackenzie* was renamed the *David Tipton* in 1907 (after only slight modifications), and serv-

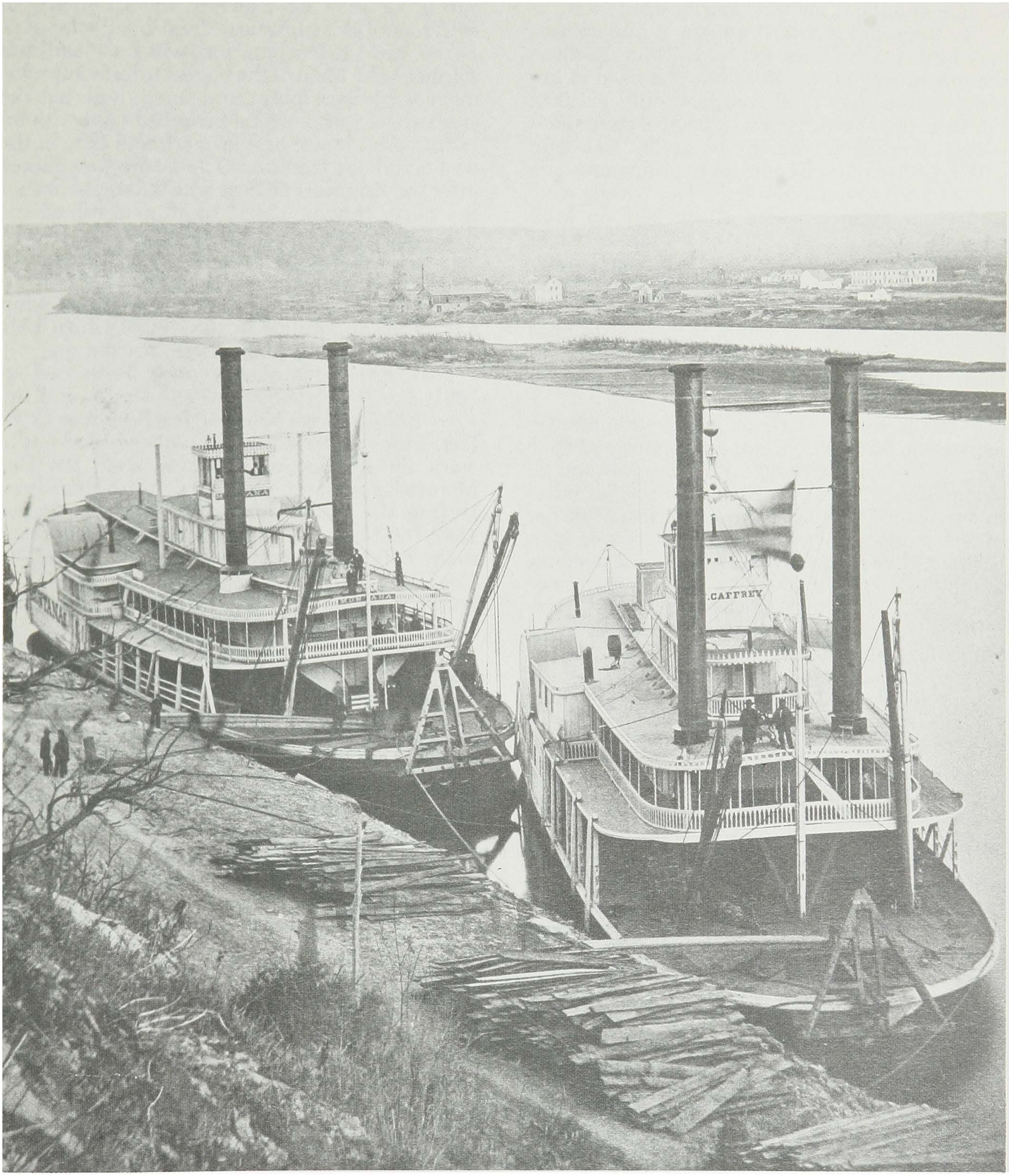


FIG. 31. The *Montana* and the *Caffrey*, first steamboats of the Rock Island District, at the St. Paul waterfront. Here they are outfitted as dredge and snag boats.

—*National Archives*

ed as a snagboat for the District until 1921.

The *General Barnard* was the grandest boat ever built for the Rock Island District. Because the machinery of the *Montana* was used in her construction, her total cost was only $21,000. For this, the District got a sidewheel steamboat whose overall dimensions were 220 feet long with a 64-foot, 3-inch beam (extending out over a 37-foot hull) and a 5-foot hold. Her wheels were 25 feet in diameter with 12 buckets on each wheel. She contained a total of 17 staterooms, of which the 6 aft rooms were 9 by 12 feet. On her decks a crew of 15 to 38 lived and worked. From the waterline to the top of the pilot house she stood 44 feet, 6 inches. She was 55 feet, 5 inches to the top of her stacks. Yet in the best river tradition she carried her 500 tons on a draft of only 39 inches.

In her 22 years, the *General Barnard* removed 38 wrecks, 6,584 snags, cut and removed 73,935 leaning trees, pulled back 1,621 trees, assisted 82 steamboats off bars, and travelled 130,732 miles in service to the Rock Island District. After her initial cruise in 1879, C. W. Durham, who became Master of the boat for several seasons, wrote to Colonel Mackenzie: "I have the honor to state that the *General Barnard* . . . has fullfilled my most sanguine expectations, and is admirably fitted for her work."[7]

The *Barnard* was condemned on August 22, 1900, and sent to Jeffersonville, Indiana, where she was sold at auction for $1,000.

In addition to the *Barnard*, Colonel Mackenzie added 4 small steam launches to the fleet in 1879: the *Mary*, *Bessie*, *Irene*, and *Wasp*. These were used as dredge tenders, towboats, inspections, and for general purpose work.

The River and Harbor Bill of March 3, 1881, provided for construction of a light-draft snagboat to be used in connection with the *General Bernard*. Then on April 4, the Chief of Engineers authorized Colonel Mackenzie to build two medium towboats. All three of these boats were designed by Montgomery Meigs, the first of a long series of Meigs' designs.

The two towboats, the *Fury* and *Vixen*, were built during the spring and summer of 1881 by Joseph Reynolds of Dubuque. They were identical sternwheel boats, 100 feet long with a 20-foot beam and a 26-inch draft. Their wheels were 13 feet in diameter. The *Fury* (U.S. Towboat No. 2) came out October 3d, and the *Vixen* (U.S. Towboat No. 3) on November 10. The boats cost $12,000 each.

The snagboat was designed and drawn during the fall of 1881 and built in the winter and spring of 1882 by Howard and Company of Jeffersonville, Indiana. This boat, the *J.G. Parke*, was 140 feet long with a 28-foot beam and a 4-foot hold. Most of the boats built for improvement work were plain and functional, but the sternwheel Parke was a beautiful boat with an ornate pilot house and gingerbread trim in the best riverboat tradition. The *Parke* was named after the Engineer Officer who was a member of the party that in 1849-50 had determined the Iowa-Minnesota Territory line, and who served as chief astronomer and surveyor of the party marking the Northwest Boundary in 1857-61. The boat cost $18,750, and performed snagging and other operations in the District until 1904 when she was condemned and broken up.

Two other steamboats were purchased in 1881, the *Alert* (U.S. Towboat No. 1) and the *Coal Bluff*, a large boat 148 feet, 7 inches by 28 feet, 4 inches weighing 175 tons, which went to work on the section of River from the Des Moines Rapids to the mouth of the Illinois River. During the disastrous floods in the spring of 1882, the *Coal Bluff* and the *Barnard* were sent to the relief of flood victims below St. Louis. The *Coal Bluff* carried 1,689 barrels of meal, 383 boxes of bacon, 17 bales of tenting, and other freight on this trip to Vicksburg.

The *Coal Bluff* was another of the District boats with a miraculously long life, still going strong in 1922. The District fleet received good care, undergoing frequent repair and rebuilding, with the result that it was not unusual for these wooden boats to last 30 or more years, in stark contrast to the fleeting life of the average commercial packet. The *Geyser* may hold the record. This small dredge was built by Meigs at Keokuk in 1893 and worked until it sank next to the dry dock at Keokuk in the late 1940's.

By 1882, in addition to the above steamboats, the Rock Island District fleet consisted of 55 stone barges and the necessary complement of quarterboats, pile drivers, and fuel flats. However, there were still not enough boats and machinery on the River, either in government or private hands, to carry out the 4½-foot channel project at the rate it was being funded by Congress. In 1882 Assistant Engineer E.F. Hoffmann investigated different types of dredges at Keokuk, Chicago, and Beardstown, Kentucky, and decided that a boom dredge was best suited to work on the Upper Mississippi. Such a dredge, the *Vulcan*, was added to the fleet in 1883. An 80-foot by 30-foot hull was built by Jacob Eckhart at Davenport, with plans

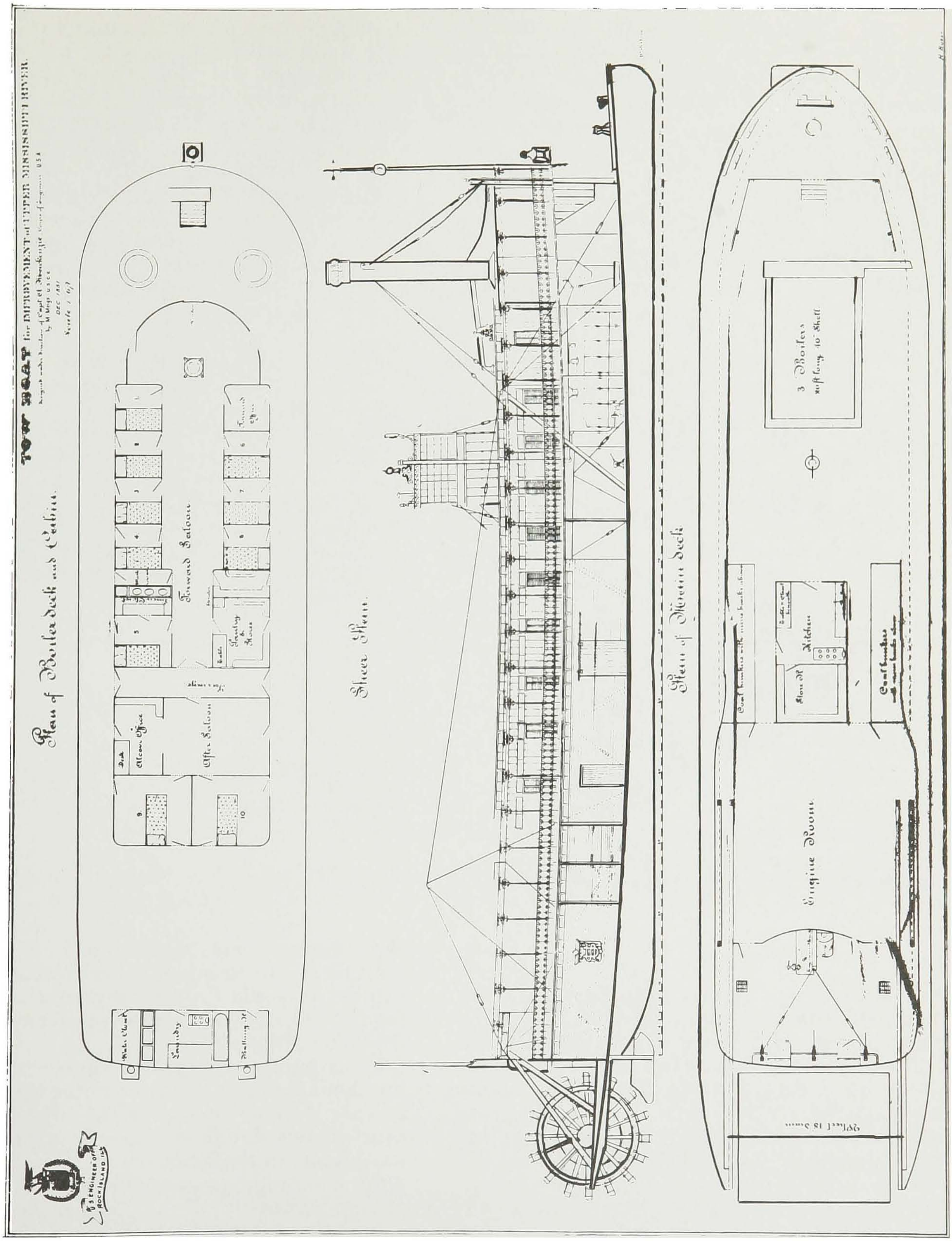



FIG. 32. Plans of the U. S. Steamboat *J. B. Parke*, the grandest of all the boats designed at Keokuk by Montgomery Meigs.

—*National Archives*

FIG. 33 The Rock Island District snagboat *General Barnard,* built in 1879 using machinery and parts from the *Montana.*

furnished by the Osgood Dredge Company (who furnished the machinery for this and many other private and Government dredges). The hull was taken to the Canal Shops at Keokuk where an expert from the Osgood Company installed the machinery. The 1¾ cubic yard capacity of the dipper made the *Vulcan* slightly larger than the *Ajax*. The boat displaced 210 tons, drew 3 feet of water, and carried a 5 days' coal supply. The total cost of the *Vulcan* was $29,348.11. It was placed in operation on August 8, 1883.

Two small steam launches, the *Stella* and *Louise*, were designed and built for towing purposes at the Canal Shops in 1884. In 1885 a third dipper dredge similar to the *Vulcan* was built for the Rock Island District at Metropolis, Illinois. This was the *Phoenix*, which worked in the District until 1916 when she was sold to the St. Louis District.

Montgomery Meigs designed and built another small steam launch at the Canal Shops in 1885. Named the *Lucia* after one of Colonel Mackenzie's daughters, she soon became the sweetheart of the Rock Island fleet. She was a plain-looking boat; nevertheless, she remained Meigs' favorite of all the boats he designed.

The *Lucia* was the Upper Mississippi's equivalent of the "little engine that could." Smaller than most of the District boats with a 78-foot length, a 16-foot beam, and a 24-inch draft, her 9-foot sternwheel turning 25

revolutions per minute, the *Lucia* performed a wide variety of tasks on the Mississippi. She acted as dredge tender, she towed barges, placed buoys on the rapids, got booms in for the winter, worked on levees during floods, and carried distinguished visitors up and down the River.

During periods of flood (which were frequent through the 1880's) she worked the bottom lands where the Des Moines River meets the Mississippi. When this area flooded, the *Lucia*, rowboats in tow, would paddle around the flood plain rescuing people from roofs and upper windows. The rowboats would bring them to her crowded decks. At night during the floods, the *Lucia* would turn her searchlight straight up to act as a beacon for boats engaged in rescue work.

Cornelia Meigs, the author and daughter of Montgomery Meigs, remembers the *Lucia* well. In a letter to the Rock Island District she recounted how the *Lucia*'s pilot-captain, Billy Adams, and her engineer, Tom Noonan, had worked faithfully on the boat for 20 years without speaking to each other, for they were sworn enemies. When the *Lucia* capsized in a tornado just above the Keokuk bridge, Adams was not on board, but Noonan died at his engines trying to keep up power, one of the very few fatalities in the history of the District fleet.

The *Lucia* had her hull rebuilt in 1895, and was still going strong until well after World War I.

By 1887 the Rock Island District had 11 steamboats and some 100 barges, dredges, dumpboats, and quarterboats. A portion of these were transferred to Captain Ernest H. Ruffner when he became Engineer in charge under the Mississippi River Commission of the section of the Upper Mississippi from Keokuk to the mouth of the Illinois River. Among these were the *Coal Bluff*, the *Iris*, and the *Irene*. In addition, Captain Ruffner bought a new small steamer, the *Success*, from H.M. Horton of Pomeroy, Ohio, for $6,500 in March of 1887. Originally, the *Success* was to have acted as a dredge tender for a new hydraulic dredge that Ruffner intended to experiment with. Previous hydraulic dredges on other river systems had been used with mud and silt, but the sand of the Upper Mississippi presented new problems. However, all bids for the dredge were too high.

FIG. 34. U. S. Snagboat *Col. Alexander Mackenzie*, which replaced the *Barnard*.

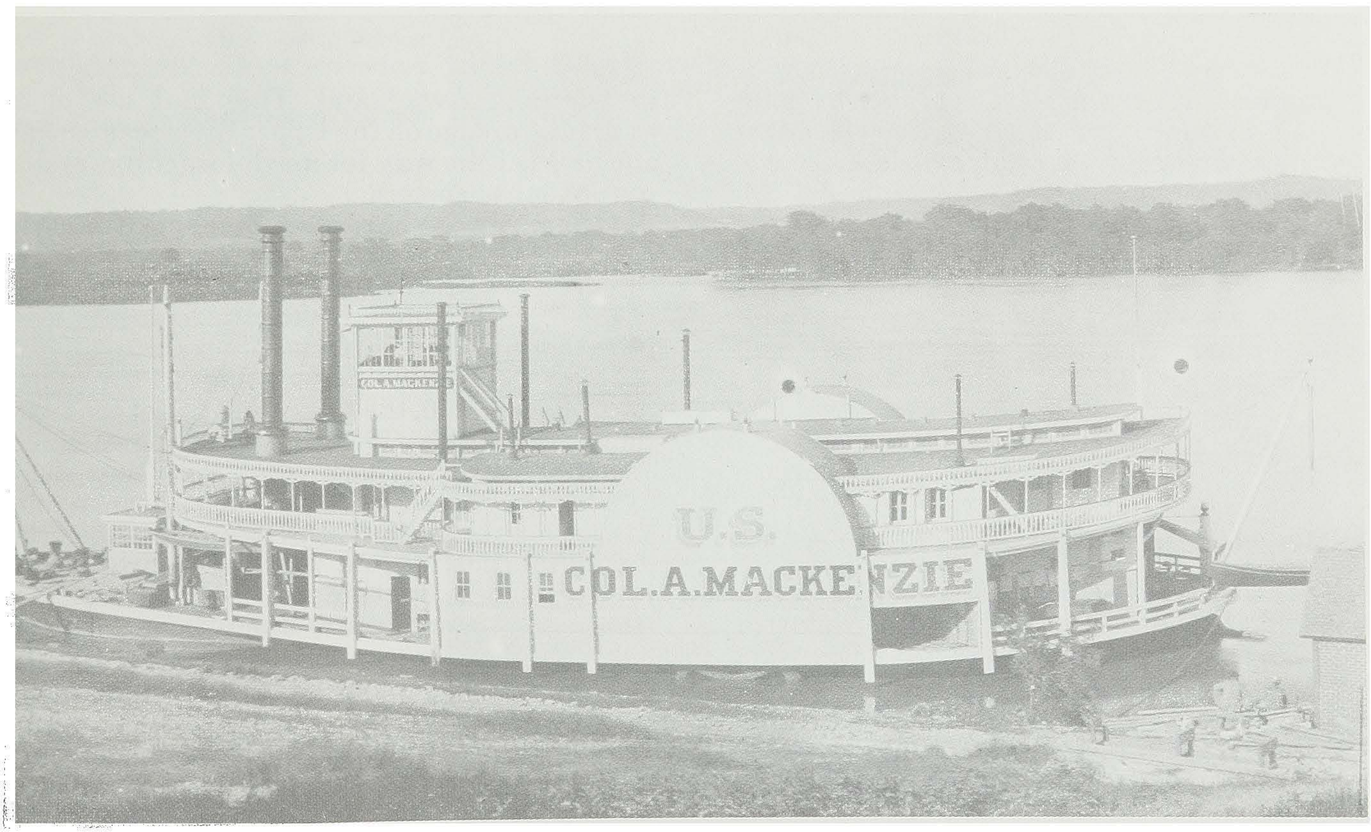



FIG. 35. The *David Tipton*, last of the Rock Island District snagboats.

Captain Ruffner solved the problem by determining to make the *Success* herself into a hydraulic dredge. New dredge machinery was ordered and the *Success* altered to fit this equipment.

Some sort of hydraulic dredge was badly needed on the improvement projects. Dipper dredges worked well on rock, but in sand the bars reformed as quickly as the dippers were able to take sand away. During the fall and winter of 1887 the *Success* was outfitted with the machinery. Three boilers furnished steam for a 12-inch centrifigal pump, the force pump, a steam hoister, and the *Success*'s own engine. Attending her was a fleet of flats bearing 500 linear feet of discharge pipe.

Due to reduced appropriations the *Success* was not put into commission until August of 1888. Her first job was to aid the St. Louis and St. Paul Packet Company, whose famous boat *War Eagle* had been aground for a long time. After pumping for 36 hours, the *Success* freed the large packet. After appropriations became available on August 11, the dredge moved to Whitney's Bar Crossing for her first experience in pumping river sand. This first use of a hydraulic dredge on the Upper River was a good one and led the way for much larger hydraulic equipment to come.[8]

Apparently the hard work demanded of such a small boat was too much, for the *Success* lasted only until 1893, the year the section of the river in Captain Ruffner's charge was transferred back to Colonel Mackenzie.

As the work on the 4½-foot channel expanded from 1890 to 1900, the Rock Island fleet gradually increased. By 1903 the Corps owned 20 steamboats, 4 dipper dredges, two new hydraulic dredges (the *Geyser*, built in 1893, and the *Hecla*, built in 1901 by William Thompson at the Fountain City Boatyard), 22 quarterboats, 18 office boats, 3 steam drill boats, more than 100 barges, store boats, dump boats, derrick boats, and a large number of small powder boats, grasshoppers, skiffs, and loading boats.

The coming of the 6-foot channel project increased the need for larger towboats and more powerful dredges. In 1907 the Engineer boatyards at South Stillwater, Minnesota, and Fountain City, Wisconsin, were expanded. In

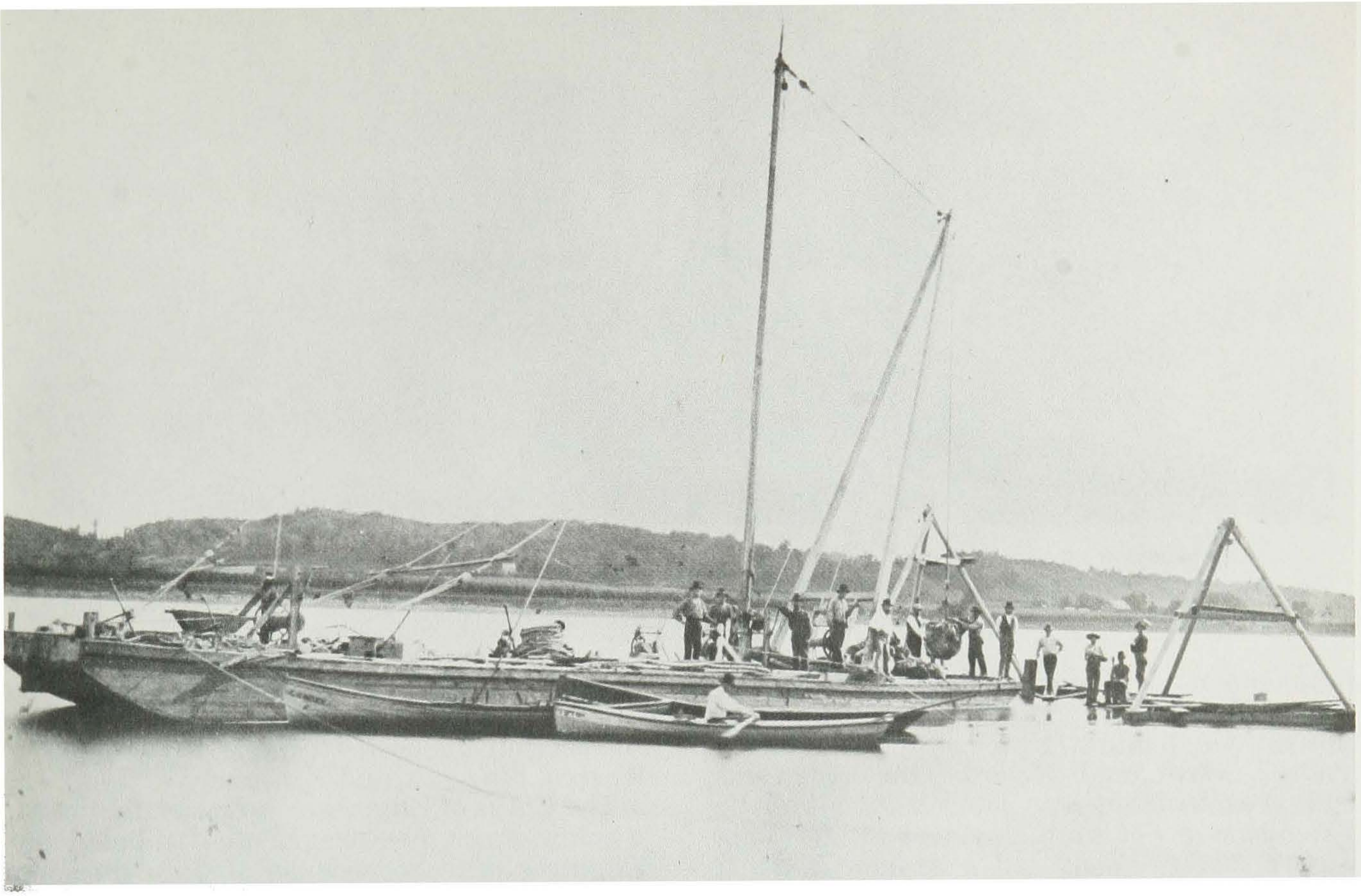


FIG. 36. Drilling tripods and a derrick boat being used to blast and remove rock from the Rock Island Rapids. A similar outfit was first used by Captain Robert E. Lee in 1838.

FIG. 37. The U.S. Steam Launch *Lucia*, named after one of General Alexander Mackenzie's daughters. The *Lucia* was designed and built by Montgomery Meigs at the Government boatyard at Keokuk.

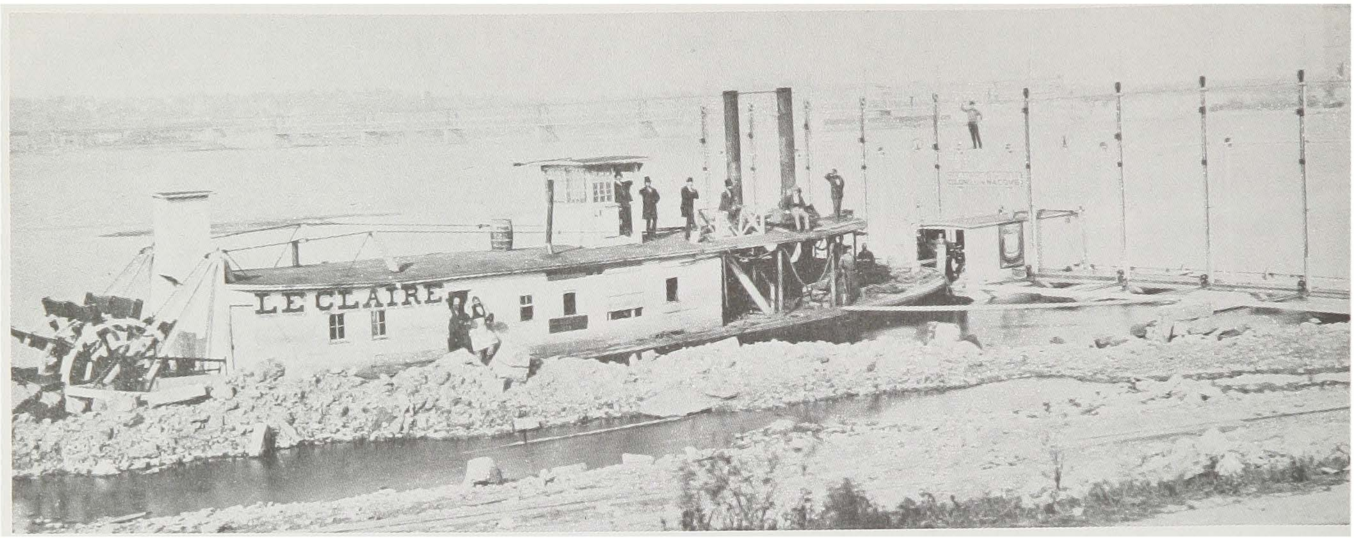


FIG. 38 The sounding machine designed by Colonel J. N. Macomb, and named after him, attached to the *Le Claire*.

June, the money having been appropriated, District Engineer Riche received permission to build 2 15-inch and 1 18-inch hydraulic dredges at the Government boatyards. One dredge was built at each of the yards. The *Vesuvius*, built by Thompson at Fountain City, was 115 feet long with a 30-foot beam and a 31-inch draft. It displaced 218 tons and used 17-inch discharge pipes. A sister ship to the *Vesuvius*, the *Pelee*, was built at South Stillwater. The third dredge, the *Etna*, with 18-inch discharge pipes, was built by Meigs at Keokuk.

These three dredges were capable of far more work than the earlier dredges. The *Etna*, for example, pumped an average of 287.7 cubic yards an hour, 3,230.7 yards a day. She made a cut 5 to 7 feet deep moving ahead at 14.7 feet per hour. In 1917 the *Etna* dredged 252,694 cubic yards—about as much as was removed during the whole Rock Island Rapids Improvement.

An appropriation of $1,000,000 in 1910 provided for three additional 18-inch hydraulic dredges. Design and construction of these dredges was assigned to Meigs at Keokuk. They were completed in 1912.

Naming of these three dredges proved to be far more difficult than building them. DuShane at South Stillwater in 1908 had suggested "Popocatopetl" as the name for what became the *Pelee*. The naming of boats apparently got further out of hand when District Engineer Charles Keller asked Meigs to pick names for the new dredges. On September 10, 1910, Keller notified Meigs that his names (what these were are not known) were not satisfactory and to try again.[9] Meigs tried again, but a week later Keller wrote, informing Meigs that he was "respectfully requested to name the new dredges *Warren*, *Macomb*, and *Farquhar*."[10]

The Corps of Engineers, however, had begun a policy which discouraged naming boats after Engineer officers, because of difficulties this had caused. (The Rock Island District had already carried this to extremes. They had named a quarterboat the *Hoffmann* in 1874, and later they had named a sounding machine the *J.N. Macomb*.) In October, orders from the Chief of Engineers to Lieutenant Keller changed the names of the new dredges to Hydraulic Dredges Nos. 6, 7, and 8. These orders also changed the name of the *Hecla* to Hydraulic Dredge No. 2, and the name of the *Etna* to Hydraulic Dredge No. 5.[11] The reason given for the order was "to avoid the use of strange and outlandish names for plant in this District."[12]

Photographs taken of boats during this period show that the names were removed and replaced by numbers. The full titles painted on the boats read as follows:

U.S. Engineer Department
Upper Mississippi River Improvement
Hydraulic Dredge No. 3

By July of 1911 names were again permissible, but names for the three dredges being constructed were still in debate. In a letter to Keller, Meigs complained that Keller's suggestions of *Sucker* and *Outcast* (note the puns) were no good. Meigs felt that the names should be *Erobus*, *Terror*, and *Stromboli*, to keep the tradition in the District of naming dredges

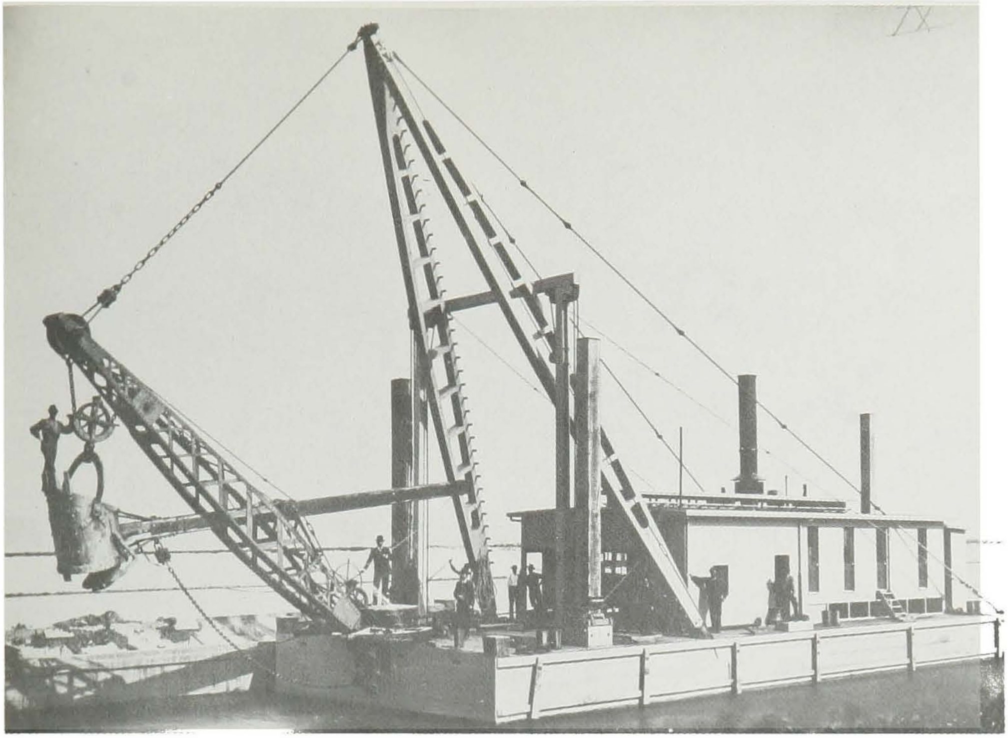


FIG. 39. One of the dipper dredges used on the six-foot channel project.

FIG. 40. The Rock Island District Boatyard at Fountain City, Wisconsin, with the hydraulic dredge *Vesuvius* nearing completion on the ways.

FIG. 41. A steam drill boat at work.

after volcanos.[13] Late in 1912 the dredges finally received their actual names: *Apo*, *Taal*, and *Mayon*, all Phillipine volcanos. The last bit of sparring in the dredge controversy came in a tongue-in-cheek letter sent to the Chief of Engineers by C.W. Durham in 1913. In that letter Durham wrote that he didn't see why "Hector," "Achilles," "Castor," and "Pollux" wouldn't work as names for the dredges, "since they are not the names of [Corps] officers living or dead."[14]

Although most of the dredging on the 6-foot project was on sandbars, much rock also still needed excavating, and to take care of this three new dipper dredges were built at Rock Island in 1914. The *Davenport*, *Keokuk*, and *St. Paul* were identical sister ships, each displacing 348 tons, built by the Rock Island Bridge and Iron Works using machinery from the Osgood Dredge Company. Each cost $56,663 to build. They had two-cubic yard dippers at the end of 45-foot booms and were able to dredge in as much as 18 feet of water.

As big and expensive as these boats were, they operated with far more economy than the simple equipment of the early days of improvement work. Each of these dredges was able to dredge an average of 26 cubic yards or 90 cubic yards of sand or mud per hour at a unit cost of 0.515 cents per yard. This compares with the average of more than 9 dollars per cubic yard paid to remove rock in 1854, and the $37 per cubic yard that Lieutenant Lee paid on the Des Moines Rapids in 1838-39.

By the end of 1914 the Rock Island District had spent a total of $2,680,795 on its fleet.

The last of the steamboats built for the Rock Island District were the four identical medium towboats, the *Le Claire*, *Minneapolis*, *Muscatine*, and *Nauvoo*, built at Grafton, Illinois, by Edward Howard in 1915. These were steel-hulled boats of 254 tons, with a length of

FIG. 42 The dredge *Rock Island*, built in 1937, one of the largest boats ever owned by the District.

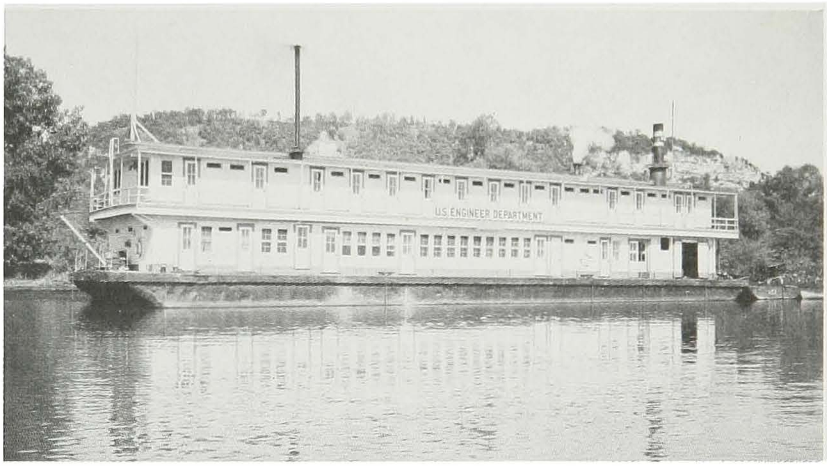


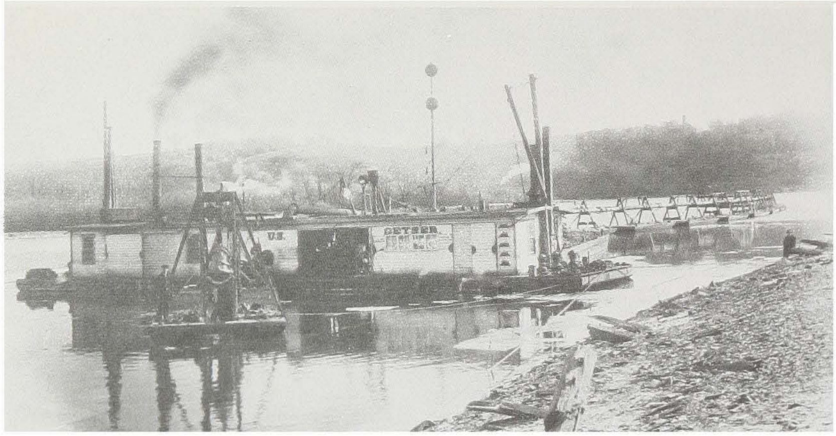

FIG. 43. A typical quarterboat used to house Government employees in the field.

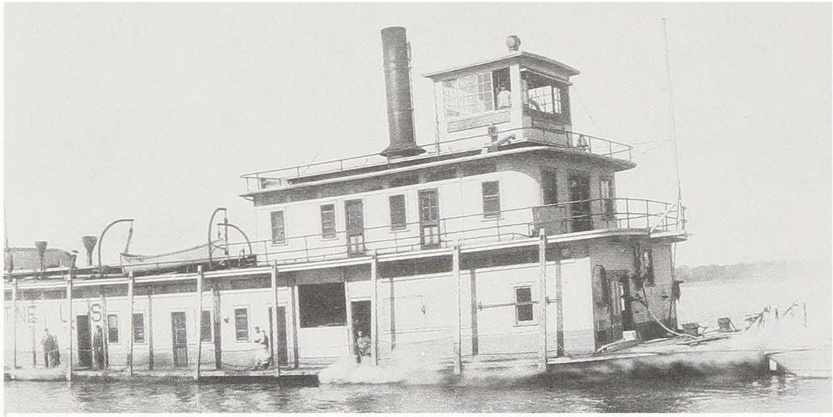
144-foot, 10-inch, and a beam of 34 feet, drawing 3 feet of water. These were nicknamed the "silo boats" by rivermen because of their height combined with their tall straight sides.

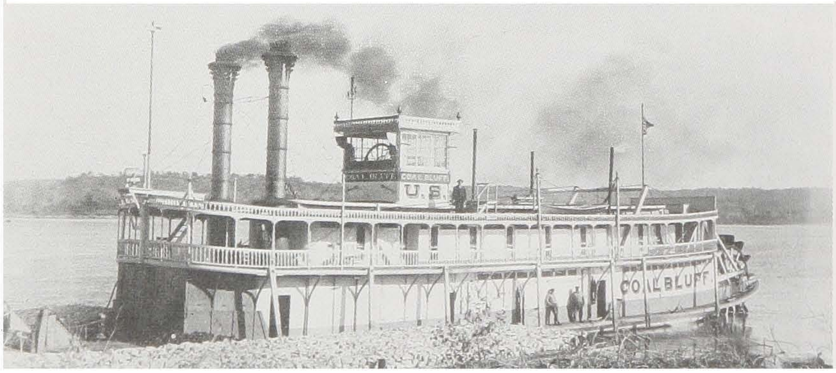
One boat which deserves special mention is the *Ellen*, the "District Engineer's royal barge."[15] The *Ellen* was built at La Crosse, Wisconsin, in 1907, and bought by the Rock Island District from the Cargill Estate[16] in 1911 for $12,000. She was an oak-hulled, 200-ton boat, 144 feet long with a 26-foot beam and a 3-foot draft. Her 18-foot stern wheel moved her along at 10 miles per hour.

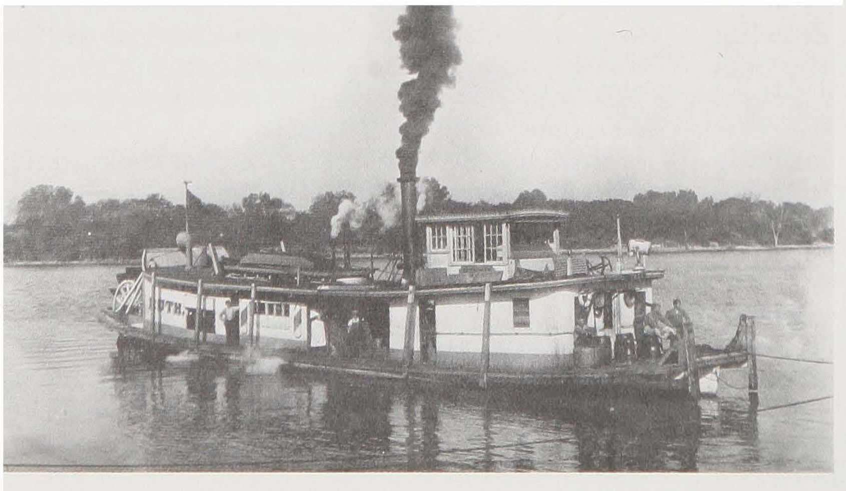
The *Ellen* became the flagship of the District fleet, inspecting, taking visiting dignitaries around, and representing the Corps at dedication ceremonies for locks and dams during the 1930's. Her captain was James Maxwell, an old riverman who had earlier worked for the Lighthouse Service, taking care of the 17 miles of lights along the Rock Island Rapids. Jimmy, the Lamp, as he was known then, made the trip between Rock Island and Le Claire daily in a rowboat, tending the lights.[17]

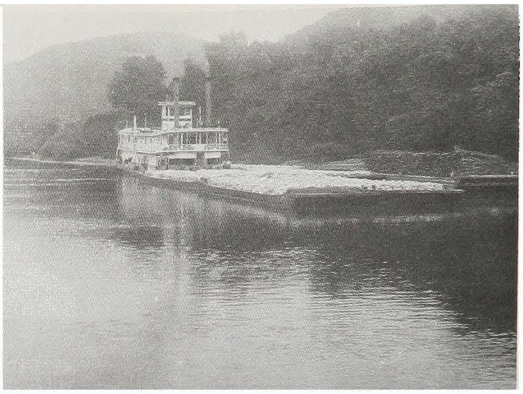
All of these additions between 1900 and 1915 increased the District fleet to the point where it was by far the largest operation on the Upper Mississippi. In 1918, when there were fewer than 80 packet and towboats left in private hands, the Rock Island District fleet numbered





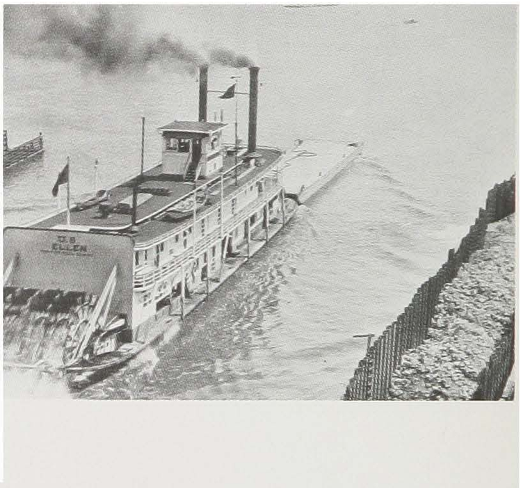



FIG. 44. Several workhorses of the Rock Island District fleet. *Left, top to bottom:* the hydraulic dredge *Geyser*; the towboat *Muscatine* (one of the "silo boats," so-called because of its height); the steamer *Coal Bluff*; the 65-foot steam launch *Ruth*, companion to the *Lucia*. *Above*, two views of the *Ellen*, flagship of the District during much of the nine-foot channel project. The *Ellen* was known as the "District Engineer's Royal Barge."

FIG. 45. The diesel towboat *Rock Island*, largest of the boats presently operated by the District.

FIG. 46. Newest of the District fleet, the *Clinton* was commissioned in 1974.

19 steam towboats, 8 hydraulic dredges, 5 dipper dredges, 4 gasoline screw launches, 12 small gasoline paddle launches, 48 motor skiffs, 233 barges, and 145 office boats, quarterboats, fuel flats, store boats, spudboats, building boats, grasshoppers, dump boats, derrick boats, houseboats, and drill boats, in addition to a full complement of lifeboats, yawls and skiffs for each of the steamers.

In 1930 the Rock Island District received its last paddle wheel boat and its first diesel power when the *Fort Armstrong* arrived. She was a medium boat, 109 feet long with a 20-foot beam, and was powered by diesel electric drive with a chain to the paddle. In the late 1940's the *Fort Armstrong* was transferred to the Huntington Engineer District.

The District fleet experienced a small spurt of new growth as the District prepared for the 9-foot channel project in 1930. Thirty-one new pieces of floating plant were bought or constructed in 1930, and an additional 46 pieces were contracted or built with hired labor in 1931. But most of these were smaller boats and barges designed not so much for construction as for the growing responsibility of maintenance.

With the 9-foot project done mostly by contract, the need for an extensive Government fleet disappeared. By 1937 the fleet had been reduced to three steamboats and one diesel electric towboat. There were still seven suction dredges, but only one dipper dredge and about one-fourth the number of quarterboats, barges, and launches there had been in 1918.

Two impressive pieces of equipment were added late in the 9-foot channel project. In the summer of 1937 a new highpowered, hydraulic cutter-head dredge, the *Rock Island*, arrived in the District. At 230 feet long, with a 48-foot beam and a 4.5-foot draft, displacing 1,500 tons, the *Rock Island* was by far the largest dredge in the fleet. Four dredges the size of the *Geyser* could be placed in its deck.

The *Rock Island* was capable of making a cut 400 feet wide and 30 to 35 feet deep. Its output when operating on 2,500 feet of floating and shore line was about 1,200 cubic yards per hour. The dredge's hull was of wrought iron to resist deterioration.

Power for the dredge pump was supplied by a 1,000 horse power diesel engine. Two 650-horse powered diesel-driven generators supplied power for the twin screws for propulsion; these same engines furnished current to operate the cutter motor, and all auxiliary machinery.

The *Rock Island* was a complete unit, with a machine shop for field repairs, quarters for 68 crewmen, recreation rooms and laundry facilities.

The dredge was built by the Dravo Contracting Company of Pittsburgh, at a cost of about $1,000,000.

She worked in the Rock Island District until 1958, when she was transferred to the St. Lawrence Seaway project. Her duties in the District were taken over by a sister dredge, the William Thompson, which belongs to the St. Paul District.

A second workboat, the *Hercules*, came to the District in 1942. This derrick boat is today the largest piece of equipment in the District fleet. She is used primarily for maintenance work on the locks and dams, being used to lift lock gates out for repair and overhaul.

Two 42-foot towboats, the *Macomb* and *Monmouth*, were added to the fleet in 1942-43, and are still around. These are 350 horsepower boats which were originally of single-deck design, with a pilot house 8 feet above the water line. Two additional boats of the same size as the *Macomb* and *Monmouth* were added in 1950. These were the *Cottel* and the *Craigel*—165-horsepower, single-screw boats.

The largest towboat in the present fleet is the 850-horsepower, 64-foot *Rock Island*. Other boats in the fleet today include the *Galena*, a jet-drive boat used to make soundings and surveys in shallow water, and the channel survey boat, *Nauvoo*, a 600-horsepower day cruiser.

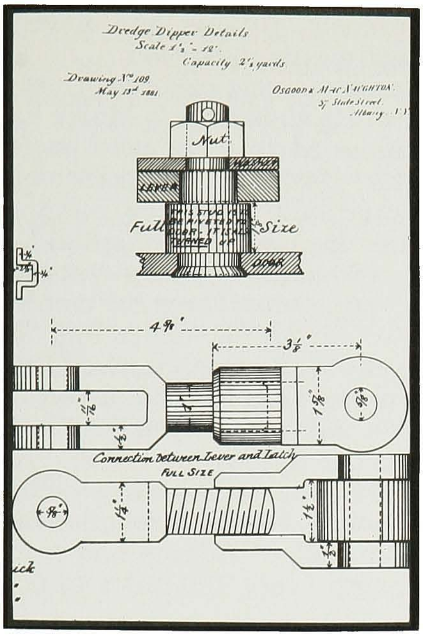
One new boat is presently under contract and due in April of 1974. This will be a twin-screw, 450-horsepower boat slightly larger than the *Macomb*, which has been named the *Clinton*.

The Rock Island District fleet has mirrored the changes in the general picture of river transportation. Today's boats are fewer and less picturesque, but they are far more powerful and more efficient than the old boats. They get a lot of work done quietly.

FOOTNOTES

Chapter VI

1. The annual *Floating Plant Reports* published yearly along with the *Annual Reports* until 1920 show how large the Rock Island fleet was. *The Floating Plant Report for 1918*, for example, shows the Rock Island District in possession of 199 named pieces of equipment (541 total plant), while the Kansas City District, next largest in number of floating plant, lists 45 named pieces (295 total).
2. Major G. K. Warren to Chief of Engineers, March 30, 1867, File 25, Letters Received, RG 77, NA.
3. Colonel Wilson to Chief of Engineers, June 19, 1868, File 1683, Letters Received, RG 77, NA.
4. Herbert Quick, *Mississippi Steamboatin'* (New York: Henry Holt and Co., 1926), p. 125.
5. Colonel Macomb to Chief of Engineers, October 6, 1877, File 71, Letters Received, RG 77, NA.
6. General Gross Barnard was a graduate of West Point in 1833, 2nd in his class. He was a professionally respected engineer in both practical and theoretical circles, publishing several engineering treatises. During the Civil War he served as Chief Engineer of the Department of Washington and the Army of the Potomac. Late in the War he became Chief Engineer of the Armies in the Field under General Grant.
7. *Annual Report*, 1879, II, p. 1106.
8. *Annual Reports*, 1888, III, pp. 1463ff; and 1889, III, p. 1720.
9. Major Keller to Montgomery Meigs, September 10, 1910, File 1652, Vol. 40, Press Copies of Letters Sent ("General Letter Books"), RG 77, NA.
10. Letter of Major Keller to Montgomery Meigs, September 19, 1910, File 1652, Vol. 40, Press Copies of Letters Sent ("General Letter Books"), RG 77, NA.
11. Major Keller to Montgomery Meigs, October 7, 1910, File 1652, Vol. 40, Press Copies of Letters Sent ("General Letter Books"), RG 77, NA.
12. Major Keller to J. D. DuShane, October 1, 1910, File 1652, Vol. 40, Press Copies of Letters Sent ("General Letter Books"), RG 77, NA.
13. Montgomery Meigs to Major Keller, July 17, 1911, File 1652, Vol. 40, Press Copies of Letters Sent ("General Letter Books"), RG 77, NA.
14. C. W. Durham to Chief of Engineers, January 20, 1913, File 1652, Vol. 40, Press Copies of Letters Sent ("General Letter Books"), RG 77, NA.
15. Interview with Robert Clevenstine, Chief of Operations, Rock Island District, June 13, 1973.
16. Cargill is a large Minnesota-based grain concern.
17. Interview with Mrs. M. F. Weissmann, April 21, 1971.




CHAPTER VII

# RIVER TINKERERS

Because every Mississippi pilot and riverman considered himself an expert on the topic of river improvement, the engineers of the Rock Island District constantly found themselves amused and often plagued by individuals and groups who knew how to improve the River with less work and more economy than the Corps of Engineers.

When G.K. Warren investigated the possible methods of clearing the channel in 1866-67, he was flooded with such suggestions, several of which he mentions in his report.[1] First, there was the plan of E.E. Bishop of New Orleans, whose plan was "to fix two large screws obliquely, one on each side of a steamboat's bow; these, driven by the engine, draw the boat through the water, and on striking a sandbar, throw the material on each side, making a way through it equal to their greatest width apart."[2]

A similar plan was suggested by Col. William R. Noble of St. Paul. His invention provided "for an arrangement of two endless screws, placed on a horizontal axis at the end of the boat, and arranged to lower to the sand. The screws, driven by steam, are made to stir up the sand, and push it each way outward."[3]

Another plan Major Warren came across was by a Mr. Jones who, obviously influenced by the adjacent farmlands, devised a plan "to drag a large plough over the bar by attaching it to the stern of a steamboat."[4]

Captain Edwin Bell, an old and respected riverman, suggested to Warren the first of what was to become a long series of inventions he proposed to the Corps, a wheel with teeth in it suspended between two boats and turned by the power of the river current. This action would be aided by scows which would lower boards along their sides to act as wing dams in channeling the current. The teeth of the wheel would churn up the sand and the current would carry it off.

Bell was something of an eccentric, though his knowledge of the river was respected. He was a steamboat captain from 1854 to 1867, when Major Warren hired him to supervise removal of snags on the Minnesota River. Captain Bell convinced Warren that "sand dams" could be created to constrict a channel by lowering boards to within 4 inches of the bottom. The current sweeping under these board walls would scour out sand and deposit it further downstream as a dam. This would do away with the need to build wing dams of brush and stone. Warren authorized Bell to make a float with sliding boards to test this invention on the Wisconsin River in 1969, and paid $400

for it. It became part of the equipment transferred to Colonel Macomb in 1870.

In the 1870's and 1880's, however, Captain Bell's relationship with the Corps grew increasingly strained. The Corps rejected a long string of Bell devices, and in turn was accused by Bell of using his ideas without paying royalties.

A long correspondence covering the tenure of several District Engineers developed over Bell's moveable wing dams, consisting of a string of barges with wooden gates along one edge. The gates were to be lowered to the bottom of the river, forming a wall to direct the current. When a section was improved, the dam could be moved to another location. Colonel Macomb ran tests on the wing dam flats in August of 1876, and convened a Board of Engineers to investigate it, but no action was taken.

The Corps paid somewhat more attention to Bell's contraption for building wing dams, which he invented after the Corps had committed itself to the 4½-foot project. This was essentially a barge tilted so that one side was beneath the water, making it easier to position material along the dam. Major Farquhar requested permission to build and test one of these in 1878.[5]

Captain Bell's final attempt to help the Corps came in 1895 when he developed a method of removing sand from the channel and depositing it in between the wing dams that had been built. This would form new banks further out in the river, so as "to make a canal in the channel."[6]

The most unusual inventor ever to have anything to do with the Rock Island District was a man by the name of Adams, who in some manner convinced Congress in 1879 that his invention, the "Adams Flume," could quickly clear the whole channel from St. Paul to St. Louis for a fraction of the proposed cost of the Engineers' plans. Congress appropriated $20,000 for Adams' experiments and instructed the Rock Island District to give him a test section of the River. Additional appropriations of $8,000 in 1882 and $15,000 in 1886 brought the total to $43,000. By 1886, however, Congress was beginning to listen to the reports of Colonel Mackenzie, and in 1887 the Secretary of War suspended Adams' work. The River and Harbor Bill of 1892 gave Adams a final $5,000 to give up all claims.

Colonel Mackenzie investigated the remains of the Adams Flume in 1892 at the request of the Secretary of War. He found a few sections of pipe, some sheet iron, and a 5 horsepower pump. No section of Adams' pipe had ever been in the River; apparently, Adams had never gotten around to testing his invention.

Adams was never very clear as to just how his flume worked. He showed it to Major Farquhar in 1877 (who tried to convince him it would never work). Basically, it consisted of a triangular pipe laid down the middle of the channel. The pipe had rows of small L-shaped jets. Adams proposed to pump water through the pipe under pressure. The water coming out of the jets would stir up the mud, sand, or gravel, and the current would wash it away. In a letter to the chairman of the River and Harbor Committee in 1886, Adams claimed that "to lay it in one unbroken line in the center of the river from its head to the Gulf will scour a channel the necessary depth and width throughout and keep it open all through."[7] Adams had counted on one small pump every 100 miles to power the operation.

Outsiders were not the only tinkerers on the Upper Mississippi. The Engineers themselves proved to be innovative in their development of methods and equipment. Some of these have already been mentioned: Lee's drilling rigs at the Des Moines Rapids, the design of snagging and dredging equipment suited to the Upper River, Wheeler's use of Portland cement on the Hennepin Canal, and Farquhar's steam scows.

Engineers like Meigs were natural tinkerers. Meigs used the excess steam from the Canal lock operation to heat the Engineer Office; he experimented with adapting garden squirts as boat pumps; and throughout his career with the District he tinkered with boats and engines. He was perhaps the only man to design a dredge hull "for just a bit more speed." One of Meigs' inventions used on many subsequent projects was a canvas coffer dam developed for the Des Moines Canal project. This permitted engineers working on locks to circumvent the normal crib cofferdam.

Another inventive engineer in the Rock Island District was E.F. Hoffmann who supervised the Rock Island Rapids improvement. In 1868 Hoffmann perfected a model of a diving bell to be used for raising stone, but money for a full-sized model, though requested, was never appropriated. Hoffmann also developed a moveable cofferdam and a tamping machine for exploding mines and dynamite.

The most useful of Hoffmann's devices was a self-registering sounding machine designed in 1874. This machine allowed a tremendous increase in the number of soundings a survey crew could make. The sounding machine was built on

a barge, and towed by a steamer. Its operation was described in the *Annual Report* for 1875:

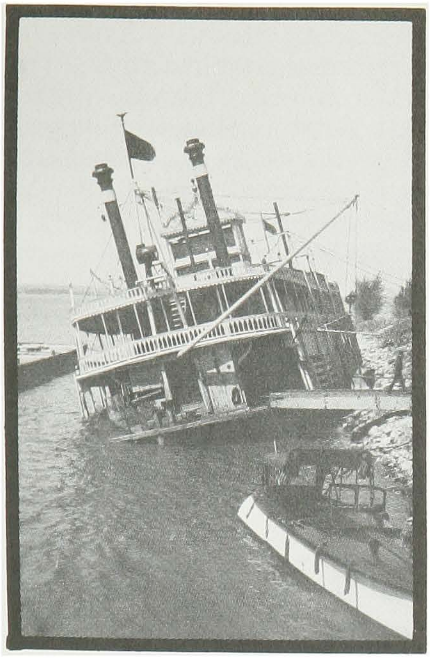
> The self registering sounding machine, which is pushed by a small steamer and worked by the capstan of the boat, covers a width of 100 feet, upon which ten sounding poles are fixed, which descend simultaneously and perpendicularly at option from one to six times per minute, so that from ten to sixty soundings in that time can be made and recorded. In practice, forty soundings per minute is the maximum, because the observers of theodolites on shore are unable to read with accuracy more than four bearings in a minute. The machine saves, when in use, ten men with poles and ten recorders, and the recording apparatus throws out very distinctly and accurately the profile of the river bed. The depth to which the poles descend is 14.5 feet. It could be increased to 20 feet in depth with attached pieces to the poles.[8]

This was the machine later named the *J.N. Macomb*.

FOOTNOTES

Chapter VII

1. U.S., Congress, House, *Letter from the Secretary of War in Answer to a Resolution of the House, of December 20, 1866, Transmitting Report of the Chief of Engineers, with General Warren's Report of the Surveys of the Upper Mississippi River and Its Tributaries*, Executive Doc. 58, 39th Congress, 2d Session, 1867.
2. *Ibid.*, p. 27.
3. *Ibid.*
4. *Ibid.*
5. Major F. U. Farquhar to Chief of Engineers, August 6, 1878, File 71, Letters Received, RG 77, NA.
6. J. D. DuShane to Colonel W. R. King, August 22, 1895, File 1652, Vol. 6, Press Copies of Letters Sent, RG 77, NA.
7. *Annual Report*, 1888, III, p. 1512.
8. *Annual Report*, 1875, I, p. 466.



CHAPTER VIII

# THE DECLINE OF RIVER TRAFFIC AND THE SIX-FOOT CHANNEL

Critics of the Corps of Engineers have pointed with irony to the fact that as the Engineers of the Rock Island District continued to improve the River, traffic on it continued to decline. They have suggested that the methods adopted by the Corps were wrong, that the work done was too small to make a difference, and came too late, or that river improvements were futile and expensive attempts to artificially keep alive an older form of transportation whose decline was natural.

At least one District Engineer supported these views, Col. C. McD. Townsend, writing from Rock Island in 1910, felt the decline of river traffic was "due to natural law."[1] He felt that the river had had the advantage when animal power (such as a team of horses) was used over land. A team of horses could haul 200 tons on a canal boat, but only 10 tons over steel rails. But steam power and later engines made power relatively unimportant. Any amount was there to command. At this point, Colonel Townsend felt, railroads had the advantage because they could be put down wherever the need was, while water routes had never really coincided with commercial routes.[2] What happened on the Upper Mississippi between 1890 and 1920 was much more complex than such critics would suggest. In fact, although it is usual for accounts of this period to talk about a decline of traffic, there was not so much a decline in use of the river as a shift in the patterns of use. The towboat and its barges are often snowed under by the dramatic and real figures which marked the end of the lumber industry.

*Lumber.* The moment of glory on the Upper Mississippi was undoubtedly the period from 1875 to 1915 when millions of board feet of logs and lumber floated down the River to markets and sawmills as far south as St. Louis. Logging was by far the largest industry on the Upper Midwest, and it made its impact felt not only on the economy but on the shape and size of bridges along the way, and on the kind of improvement engaged in by the Rock Island District engineers. In determining the amount of curve a bend could have or the shape of a channel crossing, engineers had to pay attention not only to the maneuverability of a 300-foot packet but to the far less maneuverable log or lumber raft which might reach to 300 feet wide and 1,500 feet long, and contain nearly 10,000,000 board feet of lumber.

Lumbering had been a part of the river economy when Colonel Wilson arrived in 1866, but by 1878 it was dominant. More than 100 steamboats were employed in rafting. That year 863 rafts of logs passed the Winona Bridge. The

73 sawmills between the mouth of the Chippewa River and St. Louis had a sawing capacity of 600,000,000 board feet per day.[3]

The lumber industry remained remarkably steady, reaching a peak in the early 1890's, even though the forests were rapidly giving out. Between 1,100 and 2,100 rafts passed the Winona Bridge each year between 1890 and 1899, variations being due almost entirely to the depth of water in a given year. In 1899, within ten years of the virtual end of the industry, sawmills manufactured 2,120,562,000 board feet of lumber and 619,901,000 shingles, with a total value of about $32,000,000. During 1899 86 sternwheel raftboats were engaged in moving logs. During this same year, only 16 packet boats and 35 pleasure boats operated on the Upper River.[4]

From 1900 on, the decline was rapid. By 1902 only 75 raftboats remained; the following year, 70 were left. In 1904 50 boats towed rafts, by 1906, 20. In 1913 there were only four raftboats left, and by 1915 these had disappeared.

Prior to the Civil War, rafts were simply strings of logs tied together and floated down the river, steered by raftsmen with poles and long sweeps. The crew lived on the raft, cooking in the open, sleeping in a cabin built at the stern. By the time the Rock Island District began, bridges and increased steamboat traffic made such natural locomotion unsafe and sternwheel boats were used to push the rafts downstream. Later, when even more bridges and the narrow, improved channel at the Rock Island Rapids and the Canal at Keokuk came into being, a bow boat was added to aid steering. The bow boat was a small steamer tied sideways to the front of the raft in such a way that it could move the raft to the right or left. In this way rafts could be moved with precision.

Locking through the Des Moines Rapid Canal was often a day-long operation for these log rafts, since the strings of the raft had to be separated to fit the lock chamber. Rafts from the Chippewa River (made up at Beef Slough) were made up of six strings, 40 feet wide each, while those of the St. Croix River (made up at Stillwater) were four strings wide, with each string being 60 feet. So a Beef Slough raft 600 by 240 feet required 12 lockages through the Canal, while a Stillwater raft of the same size required 8 lockages, because it utilized the dimensions of the lock chamber better.

One problem which rafts caused to other navigation was loose logs floated from the tributaries into sloughs or chutes of the Mississippi to be made into rafts. These loose logs became an especial problem in the 11 miles of river from the mouth of the Chippewa downriver to West Newton Slough. Formerly, these logs had floated into Beef Slough, but it was closed by sandbars in 1890.

Mediating between logging and packet interests became one of the touchy responsibilities of District Engineers at Rock Island. The 1900 River and Harbor Bill stated "that it shall not be lawful to float loose timber and logs, or to float what is known as sack rafts of timber and logs in streams or channels actually navigated by steamboats in such a manner as to obstruct, impede, or endanger navigation." Lumber interests, of course, tried to get this amended, and they met with some sympathy from the Rock Island District engineers. Logging interests, they felt, were the most important of any on the river.[5]

*The Decline of Commercial Traffic.* The Golden Age of steamboating on the Lower Mississippi came in the 1840's and 1850's—an age of the huge sidewheelers, the showboats, the floating palaces. A decline had already set in before the Civil War.

On the Upper Mississippi, however, the real flood of immigrants, industry, and manufacture came immediately after the Civil War. This expansion was such that river traffic thrived in spite of difficult and dangerous conditions on the river and competition from railroads crossing the river and spreading up and down each side. The St. Louis Merchant's Exchange in 1874 reported 1,063 steamboat arrivals from the Upper River, but only 752 boats from the south, and 104 from the Missouri River.[6] The primary commodity on board was grain and produce, but ranged from hogs and horses to malt, wines, cement, and grease. A list of manufactures shipped from Moline, Illinois, in 1879 shows agricultural implements (mainly from the John Deere factory) worth $2,850,000, followed by wagons, malleable iron, paper, scales, pump organs, lumber, shingles, lath, pails, washboards, churns, and tubs.[7]

Steamboat traffic remained at a high level throughout the 19th century. In 1879, 3,760 steamboats passed the Winona Bridge. The number rose to 4,593 in 1880, and ran between 4,000 and 5,400 until 1894, when it dropped back to 3,700 boats. A few boats on the Upper Mississippi were beginning to use barges to increase their capacity, but the highest number of barges through the Winona Bridge during these same years was 1,600 in 1887.[8] The

tonnage carried by these boats was 2,300,011 tons in 1878, the year the 4½-foot project began. The tonnage reached its peak in 1895, when 6,051,786 tons were registered. By 1907 the figures had dropped back to 3,919,440 tons. However, those figures are somewhat misleading; they include lumber and logs. Much of the decline between 1895 and 1907 in the above figures was due to the loss of logs and lumber traffic.

Low water did much to affect river traffic. The decade of the 1880's had been one of high water, but during the 1890's low water hit the Upper Mississippi. During the extremely low water of 1894 Colonel Mackenzie reported that he could buy any boat on the river cheap. In the 1880's a boat with crew could be rented for $60 to $100 per day. By the mid-1890's a boat, crew, and all meals rented for $30 per day.

From 1900 on, the raw statistics show a decline both in freight and in the total number of boats. What these figures don't show is that this decline was primarily in lumber and raftboats, and that the decline of other cargo was really a decline only in long haul freight. The logs ran out and the railroads took away tbq ng haul business, but short haul carriers actually increased.

What happened, rather than an out-and-out decrease, was a shift from the more glamorous long haul packets to short haul work boats hauling sand, gravel, and bulk commodities. From 1880 to 1908, freight carried by the various packet lines (long haul) did decline from 567,180 tons in 1880 to 66,255 tons in 1908, a dramatic decrease. But during this same period the local and short distance freight hauled on the Upper Mississippi increased from 197,922 tons in 1880 to 1,783,470 tons in 1908. By comparison with another waterway, the average yearly tonnage hauled on the Illinois River in this same period was 22,000 tons.

While the raft boats disappeared completely during this period, the number of towboats and packets actually increased. In 1899 there were 16 packets operating on the river. By 1913 this had risen to 20 packets and 40 towboats. The number rose to 22 packets and 56 towboats by 1915, a year in which traffic records were broken in every division in the Rock Island District, except for the section between Hannibal and the Missouri River. (A decrease in this division was due to abandonment of a sand and gravel plant at Hannibal.)

Passenger traffic, too, held up well. The number of passengers carried by all boats in 1915 was 2,008,560. This included 779,683 ferry passengers, but even the remaining number is impressive.

Long range packet service, however, did suffer. By 1918 there were no longer any packets running between St. Paul and St. Louis. All that remained was one short line boat from Rock Island to St. Paul, one between Rock Island and Quincy, and one from Quincy to St. Louis. With the passing of the large packets, the glamour disappeared from the River. But the work remained, shifting to less exciting small gas and steam launches with barges. By 1920 the five large packets remaining on the Upper Mississippi had all been converted into excursion boats.

Shipping on the River did fall off rapidly during World War I, due partly to the difficulty of getting crews. When the economy recovered after the War, industry had lost the habit of shipping by water and river traffic remained low. In 1925 the Inland Waterway Corporation began a campaign to re-introduce the Mississippi to the Nation, and the decline in river traffic, though never as great as popularly imagined, was on the way back up.

## THE 6-FOOT CHANNEL

As the 4½-foot channel neared completion with construction of the Moline lock, it became clear that the shift in river traffic to barges, and the increasing competition from the railroads meant a deeper channel if the Upper Mississippi were ever to be competitive. Further, it had always been the intention of Congress to increase the 4½-foot channel to 6 feet. Accordingly, the River and Harbor Act of March 3, 1905, provided for an estimate to be made for securing a 6-foot channel.

Impetus for renewed work on the Mississippi came from the railroad crisis of 1906. Until then railroads had been able to handle all produce to and from the Midwestern farmer. That year a record crop throughout the Midwest overburdened the railroads and left them with not nearly enough freight cars to move the produce. Even the railroad man James J. Hill suggested making more use of the waterways.[9] As a result of this crisis, a St. Louis convention in November of 1906 formed the Lakes-to-Gulf Deep Waterway Association. They sent a representative committee to Washington to urge President Roosevelt and Congress to create a Commission to draw up a plan for comprehensive basin-wide improvement of the inland

waterways. This petition was seconded by every important river town along the Mississippi, and on March 14, 1907, President Roosevelt formed the Inland Waterways Commission.

The Commission of nine members with representatives from the Corps of Engineers, conservation groups, and others interested in river planning began active work in the spring of 1908 by taking a trip down the Mississippi. President Roosevelt went with the group from Keokuk to Memphis, occasioning the largest steamboat parade in history.

Meanwhile, the Act of March 2, 1907, authorized the 6-foot channel, to be done by wing dams, dredging, and additional locks. But the 6-foot project was more complex than merely digging the 4½-foot channel deeper. Not only would it cost an estimated $20,000,000 over a 10-year period, it would have further effects on the shape of the river. More important, the 4½-foot project had been a single purpose improvement, limited to navigation concerns. But in establishing the Inland Waterways Commission President Roosevelt wrote, "It is not possible to properly frame so large a plan as this for the control of our rivers without taking account of the orderly development of other natural resources."[10] The 6-foot channel project would need a wider frame of reference.

In addition to dredging and new locks, the Rock Island District estimated that the 6-foot channel would need an additional 2,000 wing dams, 100 to 300 feet long, and 130 miles of bank revetment.

Two locks were projected as part of the improvement. The first of these was a new lock and dam at Keokuk built by the Keokuk and Hamilton Water Power Company as part of an agreement reached between the United States and the company. The new lock, constructed between 1910 and 1913, replaced the 3 locks of the Des Moines Rapids Canal with one lock, 400 by 90 feet, with a drop of 40 feet. The power dam provided a pool of water 50 miles upstream, flooding out not only the old Des Moines Canal but the whole Des Moines Rapids, and saving the Government nearly $1,000,000 in improvements that would otherwise have been necessary for the 6-foot channel.

The Keokuk Power Dam was an especially good example of cooperation between Government and private interests on the Upper Mississippi. From the original Corps' approval in 1903 to the opening of the new lock on June 12, 1913, ahead of schedule, the power company worked closely with Montgomery Meigs and other engineers. Meigs' investigations of the potential effect of the dam showed that it would slow down the boats (about 15% of the total) that bypassed the Canal and went directly over the Rapids, and it would prove a hardship to rafters (clearly coming to an end in 1903) who used the open river, but it would save time for the majority of traffic, which used the Canal. Meigs figured that between 1890 and 1901, a single lock would have saved a total of 12,000 hours over the three locks of the Canal, a mean savings of 6/10 of a cent per ton of freight.[11]

District engineers made several changes in the original bill permitting construction of the dam. They added a dry dock to be constructed at the power company's expense, and provisions that the company provide free power to operate the locks and dry dock, and that the company construct suitable fishways as might be required by the United States Fish Commission.

Part of the agreement with the power company stipulated that there would be no delay of navigation during construction. In the end, the company paid damages to one packet company for the loss of one week. The Rock Island District gained a new improved lock, dry dock, shops and buildings. Throughout construction, respect remained high on both sides.

The Keokuk Power Dam provided navigation with an additional benefit. On November 11, 1916, the Mississippi River Commission boat *Mississippi* ran aground on a sandbar 6 miles below the dam. The dam gates were opened for an hour, giving the *Mississippi* a "flash" of 2½ feet, floating her off the bar.

The second lock to be constructed as part of the 6-foot project was a lateral canal around the Rock Island Rapids at Le Claire, by-passing the upper 3.6 miles of rapids. There was already a 200 by 4-foot channel through this chain, but it was very crooked. The Le Claire Canal project was authorized on March 5, 1914. The canal, with a low, longitudinal wall upstream, would give 6 feet of water from Le Claire to the Hampton Pool.

Maps for a lateral canal on the Rapids had been drawn by a Board of Engineers in 1888, but the Board did not specify on which side of the river the canal should be built. Engineers for the 6-foot project decided on the Iowa side for several reasons. The existing improved channel was on the Illinois side. Building a canal there would interrupt navigation. A canal on the Iowa side would be ½ mile shorter. Finally, on the Iowa side engineers could make use of Smith's Island, a long narrow strip of land close to the

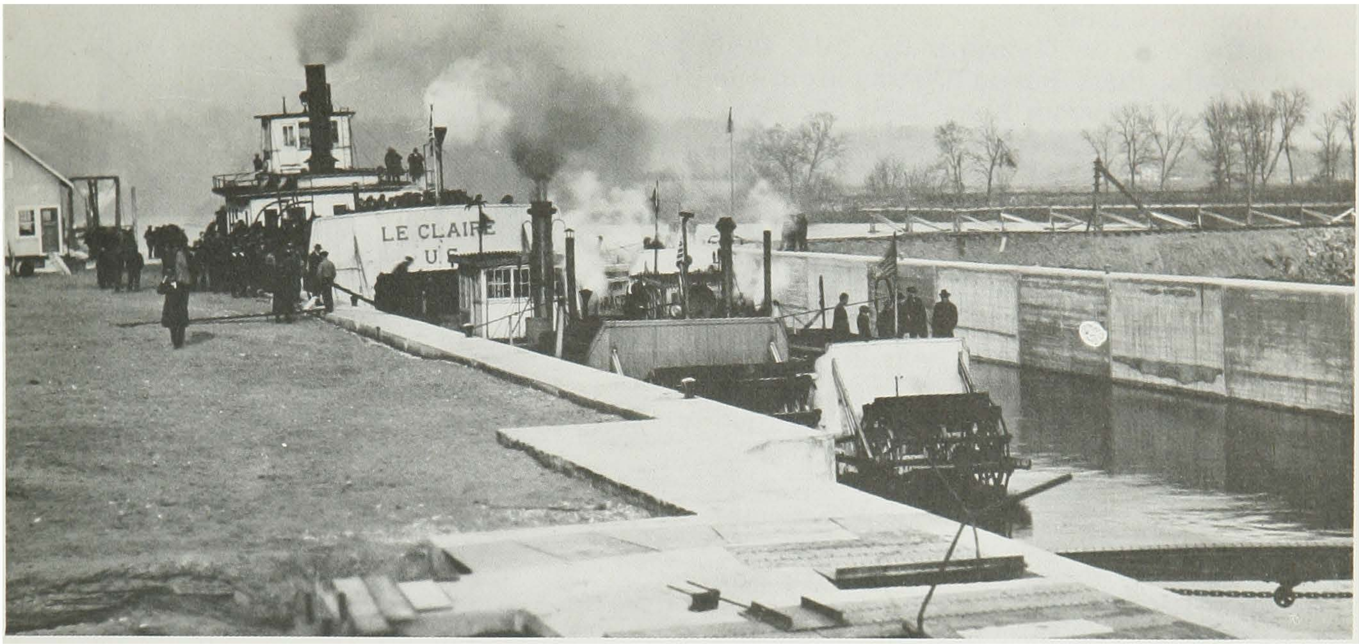
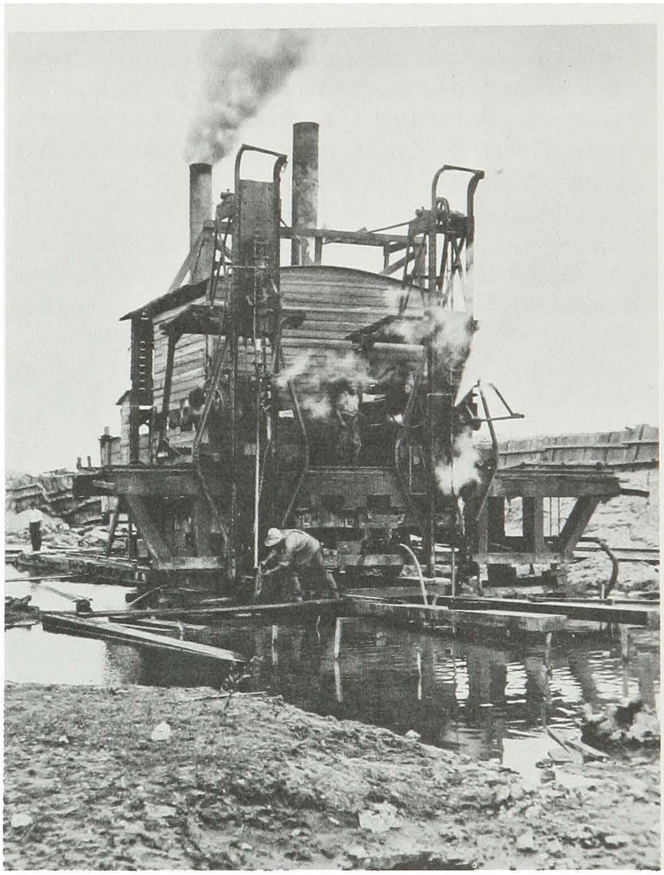


FIG. 47. Opening day ceremonies at the new Le Claire Canal, built at the head of the Rock Island Rapids as part of the six-foot channel project.

FIG. 48. A drill car at work on the Le Claire Canal, the first such machine built in the United States.



Iowa shore, as part of the dike. Using Smith's Island as part of the dike and canal wall would save nearly one mile of construction. The total length of the dike, including the island, was to be 3½ miles. The locks were designed with an 80 by 350-foot chamber.[12]

Before any construction could begin on the Le Claire project, war interrupted District activities. Other than greatly reducing work on the 6-foot channel because of the scarcity of hired labor, the War caused only minor changes in the District. Military guards were established at the Keokuk lock in 1917 to prevent possible sabotage, and the lock was declared off-limits to visitors.

There was one very minor spy scare in the District. On March 30, 1917, engineers caught a young man sketching and photographing the Illinois and Mississippi Canal above Milan. The young man claimed to be a student at the University of Chicago working on a Master's thesis. Students were suspect even then, however, and District Engineer Hoffmann wrote to the president of the University of Chicago to verify the student's story.[13]

The War did bring back Major General Alexander Mackenzie to serve as District Engineer. General Mackenzie had retired as Chief of Engineers. He arrived in Rock Island on May 12, 1917, and served until June 1, 1919. During this wartime period, General Mackenzie also served as Division Engineer of the Northwest Division. He carried out the official work of that

office from Rock Island.

After the War, on December 31, 1919, that section of the Rock Island District from the mouth of the Wisconsin River to St. Paul was transferred to the St. Paul District. This left the District with one major project, the Le Claire Canal. In addition, work on the wing dams continued. To bring the channel up to 6 feet, old dams had to be brought up to a grade of four feet above low water down to Quincy, and 6 feet above low water from Quincy to the Missouri River. New dams also had to be built.

Construction of the Le Claire Canal began in 1921. The project was opened to navigation (though not yet complete) in November of 1922. The final dimensions of the lock chamber were 80 by 320 feet, with a low water depth of eight feet at the upper sill and 7 feet at the lower. By June 30, 1924, the project was 92% complete, and had cost $2,040,632.78.[14]

Work went well on the 6-foot channel during the 1920's, even though appropriations by Congress never reached the $2,000,000 per year anticipated by the Corps when the project began in 1907. By August 1, 1928, when the section of the Upper Mississippi between the mouths of the Illinois and Missouri Rivers was transferred to the St. Louis District, the Rock Island District had nearly completed work on its portion of the River. In the 423 miles of river within the new limits of the District, only an aggregate of about 35.5 miles of channel less than 6 feet remained to complete.[15] By 1930, when the 9-foot channel was authorized, the 6-foot project was 82% complete. Since its beginning in 1866, the Rock Island District had spent a total of $20,018,042.37 on improving navigation on the Upper Mississippi River.

FOOTNOTES

Chapter VIII

1. Colonel C. McD. Townsend, "Decline of Water Transportation on Western Rivers," United States Army, Corps of Engineers, *Professional Memoirs*, II (1910), p. 27.
2. *Ibid.*, p. 20.
3. *Annual Report*, 1878, I, p. 705.
4. Information in this and the following paragraph is from the *Annual Reports*, 1890-1915.
5. Colonel Townsend to Chief of Engineers, March 3, 1900, File 1652, Vol. 10, Press Copies of Letters Received ("General Letter Books"), RG 77, NA.
6. *Annual Report*, 1875, I, p. 473.
7. *Annual Report*, 1880, II, p. 1489.
8. *Annual Report*, 1895, II, p. 2107.
9. Julius Chambers, *The Mississippi River and Its Wonderful Valley* (New York: Putnam's, 1910), p. 231.
10. President Theodore Roosevelt, quoted in Norman Wengert, "The Politics of River Basin Development," *Law and Contemporary Problems*, Vol. XXII (Spring, 1957), p. 267.
11. "Report of Mr. Montgomery Meigs, U.S. Civil Engineer," *Annual Report*, 1903, p. 1509.
12. *Annual Report*, 1916, II, p. 2607.
13. Letter of Major Hoffman to President, University of Chicago, March 30, 1917. Rock Island District Files.
14. *Annual Report*, 1924, I, p. 1090.
15. *Annual Report*, 1929, I, p. 1120.

CHAPTER IX

# THE AQUATIC STAIRCASE

In spite of continued Engineer efforts at navigation improvement after the War, commercial use of the river did not increase as much as had been hoped. Industry, manufacturers and other long haul shippers seemed to have gotten out of the habit of shipping by water.

The problems which shipping faced had little to do with the condition of the channel. Shippers and builders over the years had made little attempt to adapt boat design to either the new channel or to modern commercial needs. Most boats were still too large, too underpowered, and too clumsy to haul freight profitably. The Corps of Engineers had established an Experimental Towboat Board in 1910 under a $500,000 appropriation to design and construct two experimental towboats and several barges of more modern design. This Board met for many years, but never came to enough of an agreement to actually build any boats.

A second problem was the lack of terminal facilities, especially rail-to-river terminals. In the 19th century boats had just pulled up to the waterfront to unload their barrels and bales. Modern shipping required more modern methods. Several state legislatures were considering bond issues for terminals as early as 1913, but the War put a stop to these plans.

Finally it was the Federal government that led the way in revitalizing traffic on the Upper Mississippi. World War I had drained most of the railroad equipment out of the Mississippi Valley, and much of the Valley industry was stagnant for lack of transportation facilities. Consequently, part of the Congressional appropriation of $500,000,000 under the Railroad Control Act of 1917 was to go for boats and barges. In July of 1918 the Government-organized-and-operated Federal Barge Lines inaugurated service on the Lower Mississippi with existing equipment. The Act of June 3, 1924, authorized formation of an Inland Waterways Corporation to oversee a variety of Government activities on the Lower River.

In 1925 and 1926 several business groups in Minneapolis met with officials of the Inland Waterways Corporation and with Chief of Engineers General Harry Taylor to see what could be done about extending service to the Upper Mississippi. Inland had no boats of its own, so an arrangement was made in which the Minneapolis interests organized the Upper Mississippi Barge Line Company. In a lease executed January 20, 1926, Inland Waterways Corporation agreed to operate a fleet of boats and barges built by the new corporation from

specifications furnished by the Secretary of War.

In order to examine the state of the channel and design boats accordingly, General Ashburn, Chairman of Inland Waterways Corporation, made a trip to Minneapolis in April of 1926 with barges loaded with ballast. Based on the findings of this trip, Upper Mississippi Barge Lines contracted for 3 towboats and 15 barges. The towboats, built by the Dubuque Boat and Boiler Works, were delivered in the spring of 1927, and were put into service.

Meanwhile, the Government-run Federal Barge Lines extended service to the Upper Mississippi in 1926, scheduling 2 sailings each way (St. Louis to St. Paul) each week.

As river traffic increased, long-needed river terminals were planned. By 1928 terminals had been constructed at Burlington and Dubuque, and one was begun at Rock Island.

Various private and public groups along the Upper Mississippi began pushing Congress to authorize a 9-foot channel similar to that nearing completion on the Ohio River. After the Upper Mississippi Barge Line Company turned their boats and barges over to Inland, they devoted their time to lobbying. Strong pressure for the 9-foot channel also came from the Upper Mississippi Waterway Association, the Upper Mississippi and St. Croix River Improvement Association, from Senator Henrik Shipstead of Minnesota, and from countless other groups.[1] Rock Island District personnel, although they did not take sides openly, were also convinced that improvements similar to those on the Ohio were a necessity if river traffic were ever to make a comeback.

The 1927 River and Harbor Bill authorized a Board of Engineers to survey the river between St. Louis and Minneapolis with a view to securing a 9-foot channel of suitable width. Three years later the Act of July 3, 1930, authorized the project and appropriated $7,500,000 to begin the work, adding this to the $6,270,000 already appropriated for existing projects, for a total of $13,770,000. The Act provided that all locks below Minneapolis-St. Paul should not be less than the 110 by 600 feet established for the Ohio River, and authorized surveys for a 9-foot channel on the Illinois and Mississippi Canal and portions of the Rock River.

## THE 9-FOOT CHANNEL PROJECT

In beginning this $170,000,000 project the Rock Island District entered a new era which brought many changes. Where previous projects had been done at what now seems like a leisurely pace, the whole system of 26 locks and dams was virtually completed in a decade, from 1930 to 1940. Much of the improvement with wing dams was not visible, but the 9-foot project altered the shape of the river along nearly every mile, replacing the channel across which Sunday excursionists used to walk during the low water season with slack water pools, covering the bottom lands and creating countless willow islands where swamps had been. There was also the matter of money. The Rock Island District spent nearly as much money each year on the 9-foot project as they had spent altogether on the 4½-foot channel.

Another significant difference between this and previous projects was the coordinated planning it involved. The 4½-foot channel project never developed a comprehensive plan. District personnel took so seriously the role of the Corps as "servant of the people" that they habitually waited for Congressional direction and appropriations to plan for the coming year.

The result was a lack of uniformity. Major Riche complained in 1910 that in the two districts in his charge (he was still District Engineer of the Second Chicago District), there were 40 locks in five different sizes. These varied from the small 170-foot by 35-foot locks of the Illinois and Mississippi Canal to the Moline Lock at 350 feet by 80 feet. This lack of uniformity was continued when a Board of Engineers fixed the new power company lock at Keokuk at 358 by 90 feet, and when Congress authorized the Le Claire Canal with 320-foot by 80-foot locks. By contrast, the 9-foot project produced locks identical in almost every respect.

This was one of the most exciting periods for the Rock Island District. The interest generated by the project in cities along the River, the scope of the project, the challenge of something so big and so new, and the Depression itself all served to generate a feeling of teamwork that would be the envy of most other multi-million dollar corporations.[2] Many of the men who came to work on the locks and dams remained with the District; the last group of these men are just now on the verge of retirement.

Perhaps the best symbol of this change from old to new was the move of the District Office in 1934 from the overcrowded quarters in the Post

Office Building in downtown Rock Island to the Clock Tower Building on Arsenal Island. This move was made necessary by a vast increase of personnel in the District, especially in the engineering, legal, and real estate sections. By 1934 District quarters had spread from the Post Office Building to the Safety and Liberty Buildings in Rock Island. The move to the Clock Tower consolidated all these offices with the exception of the huge real estate division which had to be housed on the second floor of Shop I at the Arsenal.

The move to the Clock Tower Building was not only necessary, it was fitting. The building was begun in 1864 as storehouse "A" of the new arsenal at Rock Island. It was completed in 1867 under General Rodman, the Arsenal Commander, who also moved the location of the planned Arsenal to a more central point on the island. Stone for the building was quarried at Le Claire and barged down the river, while beams from old Fort Armstrong several hundred feet away were used in some of the construction.[3]

The building got its name from a large clock on top of a 117-foot tower at the front of the building. Twelve-foot dials are located on all four sides of the tower. The minute hands of the clock are 6 feet long, while the hour hands are 5 feet. The clock faces and hands are carved from wood. Weights that drive the clock hang down three stories of the tower; the pendulum itself is two stories long. A 3,500-pound bell still strikes the hour.

When the District Offices moved into the Clock Tower Building, personnel found themselves with a clear view of the new Lock and Dam 15, the first project begun on the 9-foot channel.

The first task of engineers on the 9-foot project was to establish a large real estate and lands section. Because of alterations of the shoreline caused by pooling the water, virtually every square foot of both sides of the Mississippi had to be surveyed.

The design, location, and number of dams in the project were determined by both natural conditions and the population of the Valley. The low banks of the Upper Mississippi in front of a heavily cultivated flood plain, and the close encroachment of railroad tracks and towns precluded the construction of a few high dams. This meant that the dams had to be limited to navigation control and would not be able to serve as either power or flood control structures. Low dams were also needed if the levee systems were to be kept intact.

On the other hand, the shallowness of the river itself precluded the use of dams like those on the Ohio which could be lowered into the water to pass the water in high stages.

The kind and frequency of floods in the Upper Mississippi Valley also made certain demands on the dams. The frequent concurrence of flood discharges from the whole basin indicated the desireability of moveable dams that could be raised entirely out of the water during flood stage. Then, too, the ice which broke up in spring came downstream with considerable force. Any dams on this section of the river would have to be both strong, and have wide enough openings to prevent constricting the flow of ice so as to cause ice jams.

Finally, from the preliminary planning on, the Corps of Engineers cooperated with other agencies to minimize problems the dams might cause. The low dams could not be used for power or flood control, but the Corps did work closely with the Bureau of Biological Survey and the Bureau of Fisheries, and made several modifications in design to aid area ecology. For instance, the roller gate design chosen permitted migration of fish, stabilized water levels, passed silt and sewage, aerated the water, and so benefited both wildlife and public health. Cooperation of the National Park Service was obtained to insure that areas needed for navigation but not continuously overflowed would be put to maximum recreational use consistent with the project.[4]

The 9-foot channel project resulted in a series of 26 locks and dams between Minneapolis and Alton, Illinois, an "aquatic staircase"[5] dropping 335 feet over 662 miles. The lowest lift of any of these locks is 5.5 feet at Lock No. 5A at Winona, and the largest is 38.2 feet at Keokuk Power Dam, now Lock No. 19. The Rock Island District built 12 of these, from No. 10 at Guttenberg, Iowa, to No. 22 at Saverton, Missouri.

The designing of the locks and dams was begun at the Upper Mississippi Valley Division Offices in St. Louis. All of the locks were designed here, as well as all of the electrical work. Contracts for lock machinery were also let by the Division. However, after the designs of the first two dams constructed, Nos. 15, at Rock Island, and 20 at Canton, Missouri, the task of designing the remaining dams within District boundaries was turned over to the Rock Island Office.

With the exception of Dam 15, all dams were designed with a combination of Tainter and roller gates. The decision to incorporate the

FIG. 49. Diagram of a typical roller gate, showing its principle of operation.

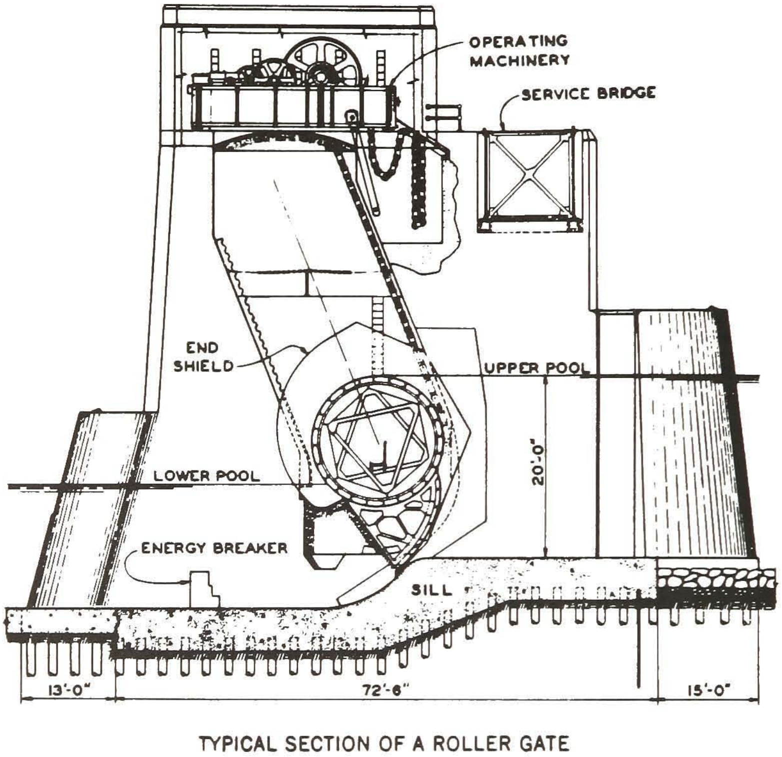
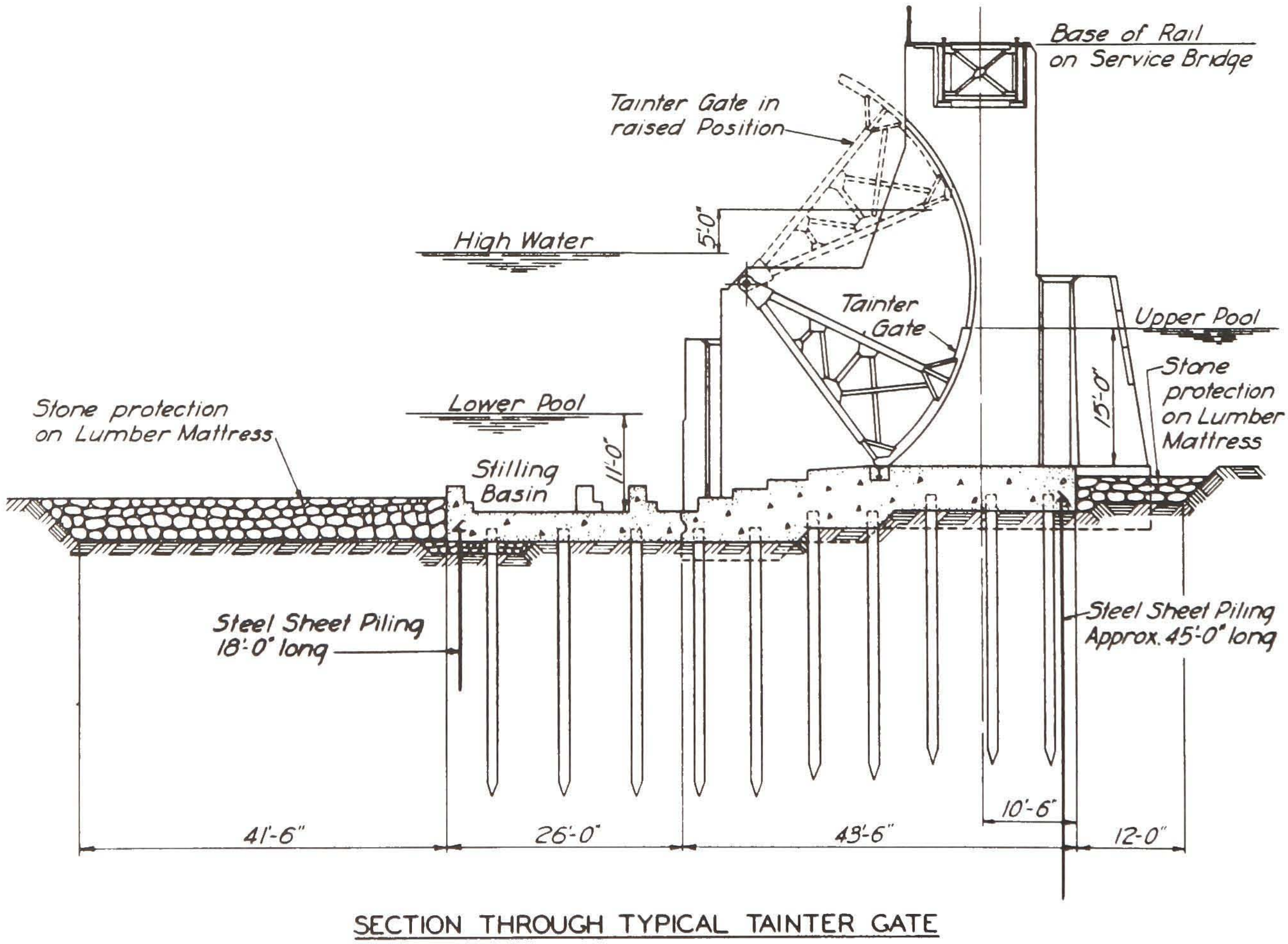



FIG. 50. A similar view of the Tainter gate, used along with rollers on most of the dams.



newer roller design was due to the need for dams on the Upper Mississippi to withstand hard usage and to provide as wide a space as possible between piers so as to pass ice and drift. Rollers were structurally sounder, and so could be made longer. Dam No. 15 was built entirely with rollers because it was constructed at the narrowest part of the channel and subject to ice jams.[6]

Tainter gates were an old French design. The gate was essentially a pie-shaped wedge with the point downstream, hinged between piers, and the curved surface upstream forming a dam against the water. The gate could be moved up and down so as to vary the amount of water flowing under it from nothing to a completely unobstructed flow when the gate was lifted entirely above the surface. Tainter gates were used wherever possible because they were cheaper to construct, and because they did not require royalty payments as did the rollers.

Originally it was the intention to use the roller sections of the dams to pass the normal flow of water, reserving use of the Tainter sections for flood times or high water. However, District engineers soon discovered that such an uneven flow of water through the dams caused extensive scouring below the dam, endangering the structures and playing havoc with the channel. Since then, all gates in a dam have been kept at about the same level. (This creates problems today at a dam like No. 20 at Canton, where the 40 Tainter gates are moved by a travelling crane—a slow process if one is attempting to keep them even. Ironically, No. 20 is the first dam below the mouth of the Des Moines River, adding to its problems.)

The roller gate had been developed in Germany and was still under patent when the dams were built. Over 100 roller dams had been built in Europe, but they were quite new as far as navigation projects in the United States were concerned. The first roller dam had been built in Washington in 1912. There were 9 other such dams in the United States before 1930.

This gate was essentially a cylinder which could be raised or lowered to control the level of water passing beneath. On the upstream side of the roller a steel apron extended along its length. When the gate was closed, the lower edge of this apron rested against a steel sill even with the riverbed. In addition to their strength, roller gates have the additional advantage of offering less friction to water passing underneath than other types of dams.

In addition to a moveable section of roller and Tainter gates, most of the dams also contained a fixed or dike section, made of earth or, less often, concrete. These fixed sections contained a combination of spillways, overflow sections and non-overflow sections depending on the requirements of a particular area.

As the construction progressed in the 1930's, advances in both design and materials permitted the construction of wider Tainter gates, decreasing the need for rollers. In 1930 the limits of a Tainter gate were thought to be 40 feet. This gradually increased; Dam No. 17 at New Boston, Illinois, completed in 1939, has 8 60-foot Tainters and 3 rollers; and Dam 13 at Clinton, Iowa, completed in 1939, has ten 64-foot Tainters and three roller gates.

Most of the dams were designed solely for navigation. However, power is still generated at Dam No. 1 under a license from the Federal Power Commission by which the Corps is reimbursed for power expenses. Water power is also developed at Dams 2 and 15 to generate electricity to operate the navigation structures.

Although the general location of the dams was determined by the rate of fall in various sections of the river, the exact location was determined to a great extent by the towns along the shore. Most dams were built just above towns so as to minimize any changes to the waterfront.

All of the locks in the Rock Island District are a uniform 110 by 600 feet, with the exception of the Keokuk lock built in 1913. This was 110 by 358 feet until 1957, when it was replaced by a new 110 by 1,200-foot lock. Each of the dams also contains an uncompleted auxiliary lock 110 feet wide by 269 feet long. Auxiliary locks at Rock Island are already complete. The locks use mitre gates electrically operated. Water enters or leaves the lock chamber by tunnels underneath the bottom.

*Lock and Dam 15.* The first lock and dam to be constructed was No. 15 at Rock Island, located on the downstream tip of Arsenal Island just below the Government Bridge which connects Arsenal Island to Davenport. The dam is situated on a diagonal, pointing downstream from the south abutment at a 16½ degree angle to the normal channel line. The maximum head or difference in pool elevation is 16 feet.

In all cases the locks were built first so as not to interrupt river traffic. The contract for two parallel locks at Dam 15 was let on April 23, 1931. By June 30 the contractor had nearly completed the cofferdam around the south ap-

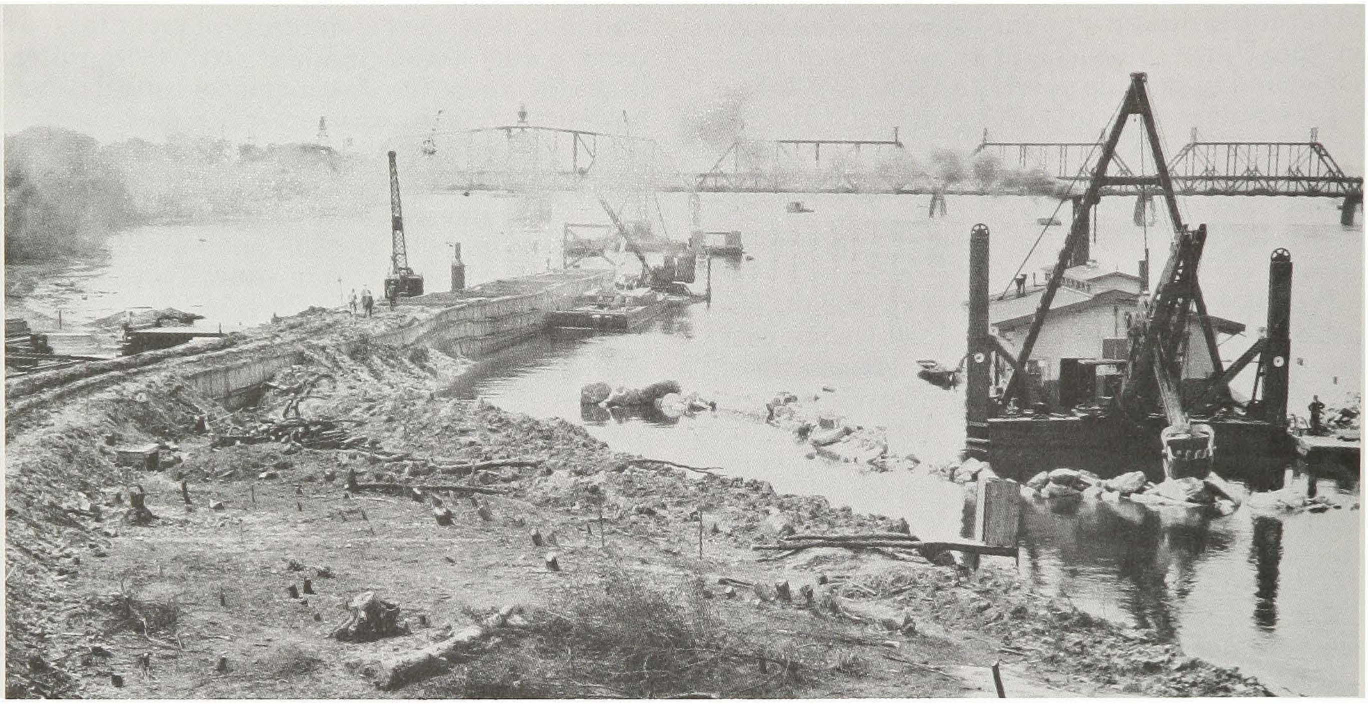


FIG. 51. Initial construction on the nine-foot channel began with this coffer dam at Lock 15.

proach to the drawspan of the Rock Island Bridge (which the locks would utilize). The main lock was completed on March 20, 1932, less than a year later, and in April construction of the auxiliary lock began. Original plans for the lock and dam system called for auxiliary locks at each dam to take care of a projected future increase in traffic, but only auxiliaries at Dam 15 were built.

Both locks at Dam 15 are 110 feet wide. The main lock is the standard 600 feet; the auxiliary lock is 360 feet. Guide walls approximately 40 feet high extend 600 feet upstream from the upper gate and 1,100 feet downstream from the lower gate. The top width of these walls varied from 6 to 40 feet, the wider portions serving to provide room for equipment, machinery, and storage and shelter houses.

Water enters or leaves the lock chamber through 4 tunnels, two for each lock. Those in the main lock are 12½ feet square; those in the auxiliary lock, 10 feet. The tunnels take water from the pool above the lock chamber and discharge into the river below the chamber. Two Tainter valves in each tunnel, one just downstream from the intake and one just upstream from the discharge ports, control the in and out flow of water.

When bringing the chamber level up to that of the upper pool, the lower valves are closed and the upper opened. The water flows into the lock chamber from the tunnels through 4 by 3-foot openings spaced 25½ feet apart in the main lock and 20 feet apart in the auxiliary. When the water in the lock chamber equals the level in the upper pool, the gates are opened to let boats in. Water flows out these same openings into the tunnels when lowering the chamber level to that of the lower pool.

The locks have mitre gates opening upstream, operated by one 25 horsepower electric motor for each leaf of each gate.

The contract for the roller dam and appurtenant sea wall and intercepting sewer was let on February 8, 1932, and work got under way in the spring. By the end of the first fiscal year of work on the 9-foot channel, the Rock Island District had completed $3,132,814.12 of work.

Dam 15 is built on a limestone ledge lying 3 to 7 feet below a layer of silt, clay, sand, and broken rock forming the riverbed. As excavation for the dam progressed a number of cavities (including 4 very large ones) were uncovered. These were cleaned of objectionable material and filled with concrete.

The moveable section of Dam 15 is comprised of 11 roller gates each 99.3 feet long, mounted between concrete piers. On each cylinder a steel

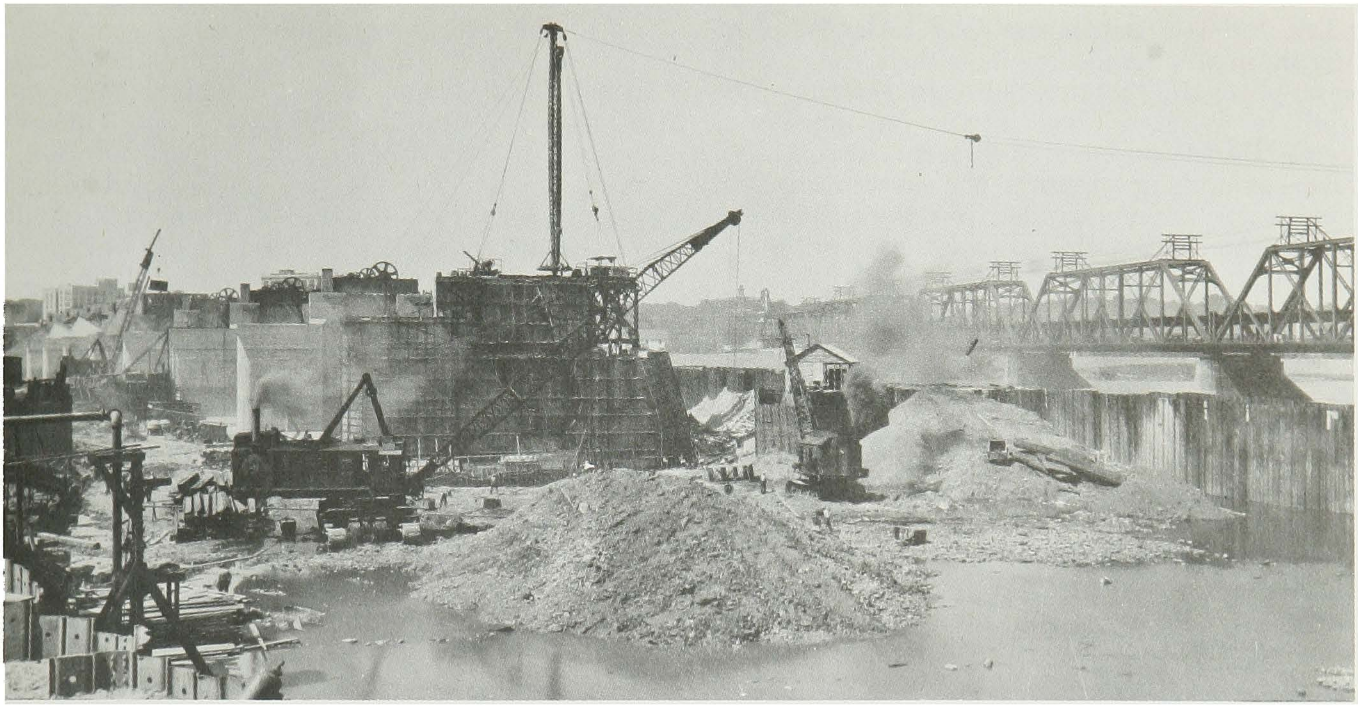


FIG. 52. Construction at Dam 15, Rock Island.

apron 13 feet wide extends full length along the upstream side.

Both ends of each gate have cast steel teeth partially encircling the cylinder; these teeth fit into cast steel racks set into the sides of the piers on an incline. The gates are raised or lowered by a link chain at the end of each roller, powered by individual 50 horsepower electric motors.

Nine of the rollers in Dam 15 are 19 feet, 4 inches in diameter. The ones nearest the Iowa and Illinois shore are 16 feet, 2 inches. These end gates, called skimmer gates, permit an overflow to keep the surface of the upper pool free of debris. The other rollers never overflow. The height of the rollers closed, including the apron, are 26 feet for the main gates and 21 feet, 9 inches for the smaller end gates.

The roller gates are operated to keep a pool elevation of about 561.0 feet above sea level, or a minimum channel depth of 9 feet at the upstream end of the upper pool. They are raised gradually as the flow increases beginning with the center and working outward. The two end gates are always left slightly raised. On the Iowa side this insures that there is always moving water at the sewer outlet, while moving water on the Illinois side provides good water for the water supply intake.

A steel truss service bridge extends over the entire length of the dam on the upstream side. On this bridge a 15 foot gauge track supports a 30-ton electric crane with a 50-foot boom, used to service the heavy gate machinery and remove large pieces of debris. On the lower chord of the service bridge is a bridge crane used to place emergency bulkheads. These are trussed skinplates which can be placed in slots in the upstream side of the piers, forming a cofferdam and permitting the rollers to be removed for overhaul or repair.

The control house for the dam is on the wall at the south end of the dam. Here there is a water power turbine for generating electricity to operate the locks and dam, and an auxiliary gasoline plant. In addition, connections to commercial power lines are available.

Lock and Dam 15 was opened to traffic in the spring of 1934. The machinery was installed in the locks by March 31, and the roller dam was completed on May 9.

One major problem caused by the lock and dam system was that raising the water in the pools interferred with many urban storm and sanitary sewers. These included the cities of Davenport and Bettendorf on the Iowa side of the project, where some 60 outlets were affected. To take care of this problem, a seawall and intercepting sewer were constructed from a

point 136 feet below the first roller gate upstream nearly 2 miles to where the natural bank gave protection. At this point the seawall ends, and a concrete box sewer of gradually diminishing size, covered by a rip rapped earth levee, extends upstream to the eastern limits of Bettendorf, about 4½ miles from the outlet. Five sluice gates are provided in order to allow the river to flush the sewer.

The total cost of Lock and Dam 15 to its completion in 1934 was about $7,480,000.

The construction of the remaining locks and dams followed similar lines. Following the design of Dam 15 and Dam 20, the Upper Mississippi Valley Division turned over the design of the remaining dams to the Rock Island District. Here a force of 200 engineers, many of whom had been out of work because of the Depression, worked on the project. The overall design of the remaining dams was supervised by James Reeves and Edwin Franzen, while Frank Ashton had responsibility for the dam gates.

Five more locks and dams were begun in the fall of 1933 after Major Raymond A. Wheeler had arrived as District Engineer to supervise the work. Lock and Dam 20 was begun in November, as was No. 18 north of Burlington, Iowa. In December work began on Nos. 16, 11 (at Dubuque), and 12 (at Bellevue). In deciding on the order in which to build the locks, Engineers followed the old practice of starting with the worst spots and ending with those having the least problem. Lock and Dam 15 had been the first because of continued problems with the Rock Island Rapids.[7]

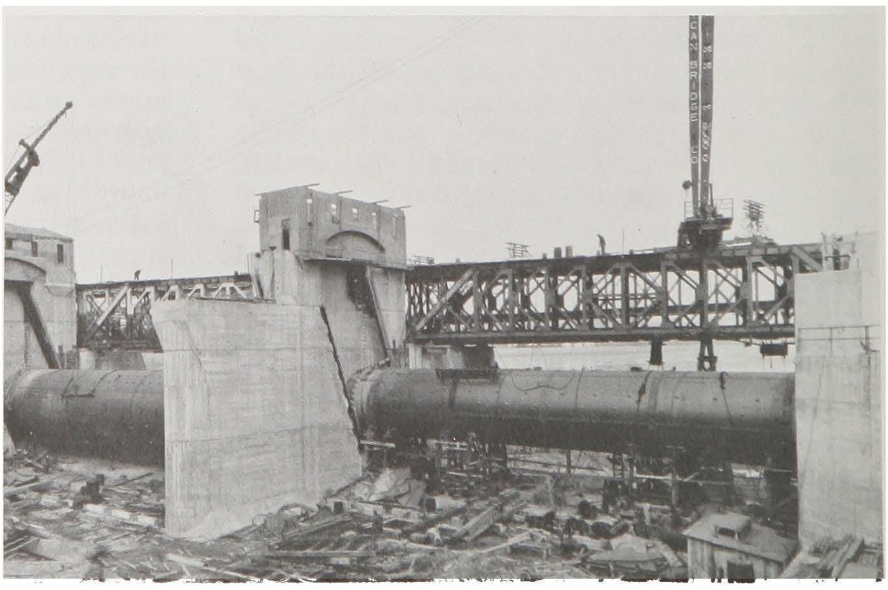
Funds for the 9-foot project came from several sources. In addition to the regular River and Harbor appropriations, $33,500,000 was allotted on June 16, 1933, from the National Industrial Recovery Act, and in 1934 additional funds amounting to $50,500,000 were allotted by the Federal Emergency Administration of Public Works. With this money work proceeded at a rapid rate. The total cost of work in the Rock Island District during fiscal 1934 was $6,390,-467.47, more than double the amount spent during the first year of the project.[8]

In 1935 the River and Harbor Bill of August 20 authorized an appropriation of the entire amount required for completion of the project. Most of the funds had previously come from the Public Works and Emergency Relief funds. For example, in fiscal 1935 regular funds paid for $51,906.98 in new work, Emergency Relief funds had paid for 19,302.23, and the rest, $11,488,-434.03, came from the Public Works Administration.[9]

Lock 10 at Guttenberg was placed in operation on May 25, 1936, even though the dam was not yet done. Later that year, operation and maintenance of this lock and dam was transferred to the St. Paul District. By 1939 the last of the locks and dams were nearing completion. Nos. 12, 21, and 22 were finished in 1938. In April, 1939, Nos. 13 and 17 were completed, and in June the last lock, No. 14 at Le Claire, was opened to navigation.

By June 30, 1940, a controlling depth of 9 feet had been reached in all pools in the Rock Island District at a total cost to that date of $69,609,-229.44. The original estimate for the entire

FIG. 53. Roller gates in place at Dam 15.



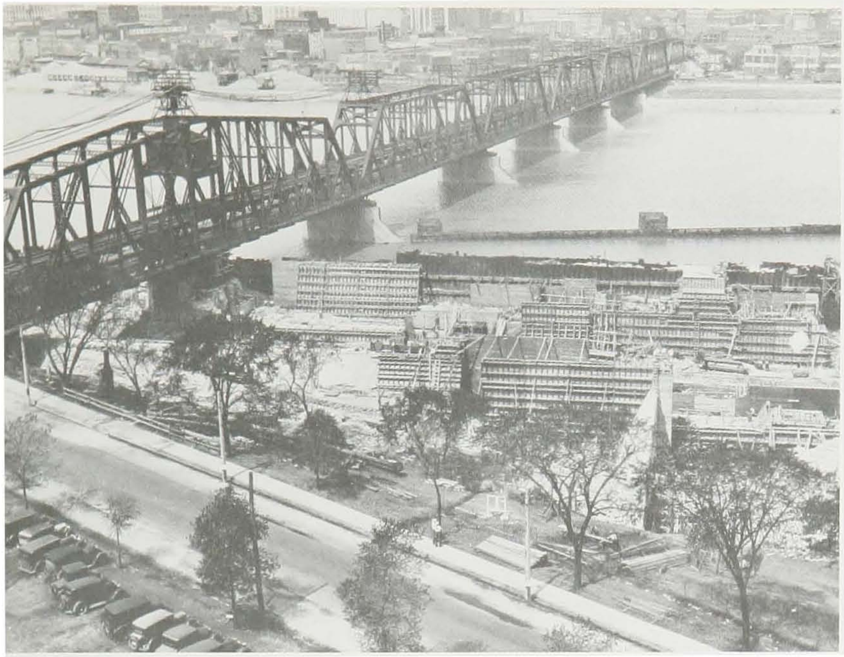
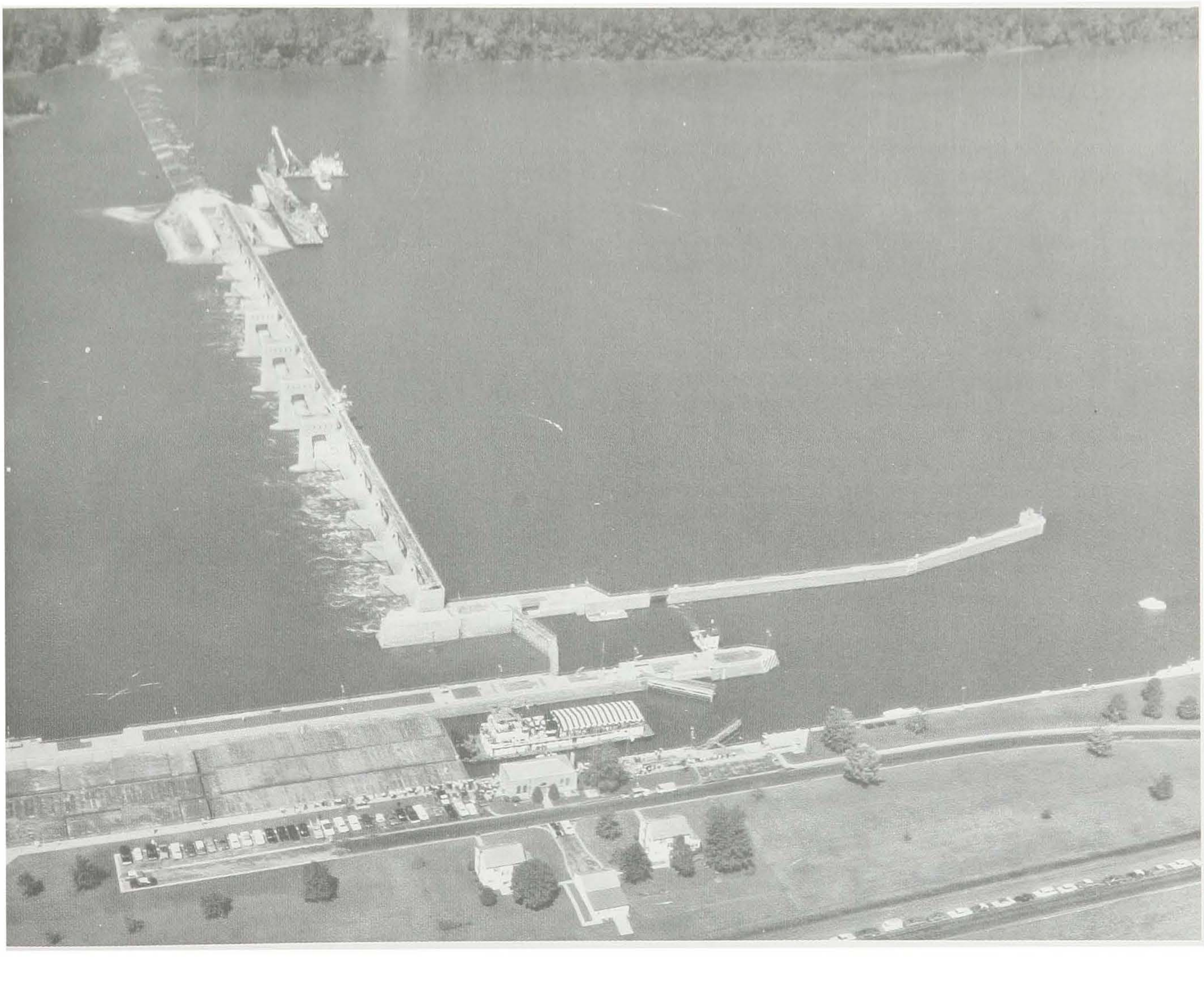


FIG. 54. Construction at Lock 15.

FIG. 55. A view of Lock and Dam 21 at Quincy, Illinois, showing all of the typical components: locks, Tainter and roller gate sections, spillway, and levee.



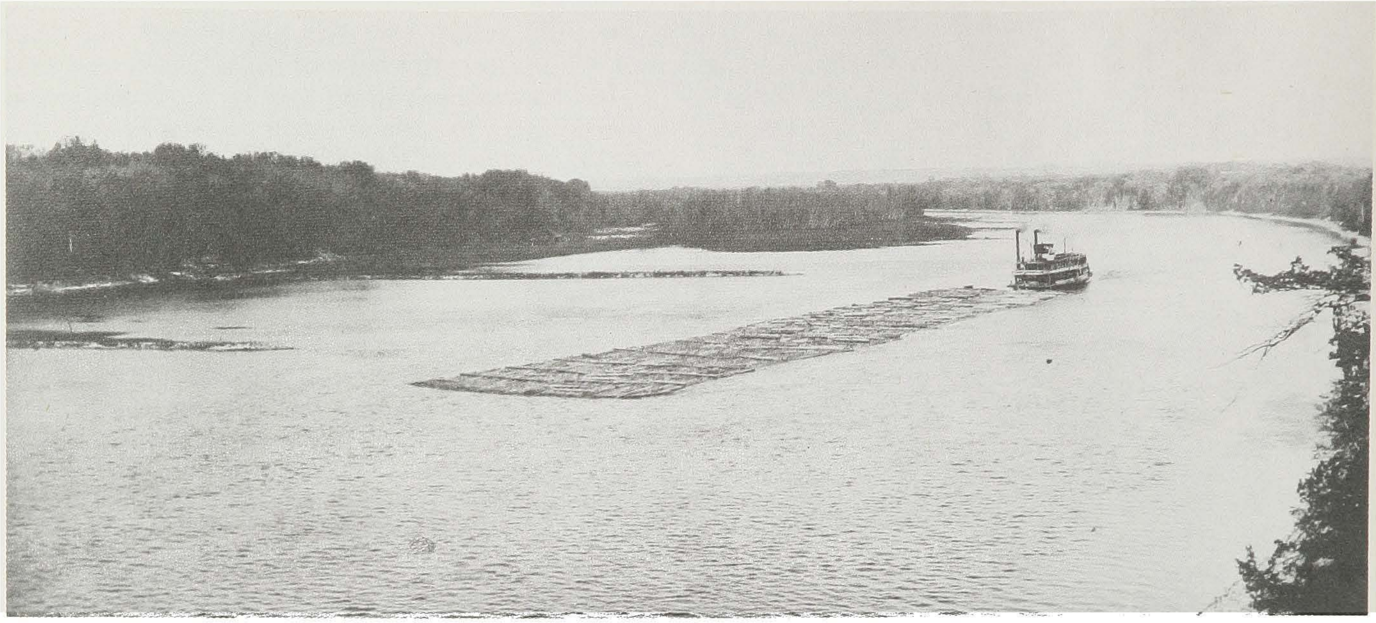


FIG. 56. A raftboat pushing a tow of logs, a common sight on the Mississippi until 1918.

project in 1931 had been $140,000,000. This was gradually revised upward by 1940 to $170,000,000, partly due to changes and additions made to the project as it went on.

*Effects of the 9Foot Channel.* The 9-foot channel project began to make a difference on the Upper Mississippi even before it was finished. The Upper Mississippi Wildlife and Fish Refuge Act passed in 1924 authorized the Biological Survey to buy overflow lands of the Upper Mississippi Valley. At first it was felt that the 9-foot channel would ruin the potential of the Valley for a wildlife refuge.

However, as the first pools were filled, the cooperative planning between the Engineers and the conservationists began to show results. In 1937 Ira Gabrielson, Director of the Fish and Wildlife Service, wrote in an article in *Scientific American*:

> A fine example of how large dams may help the wildlife resources is developing now on the Upper Mississippi River Wildlife Refuge near Winona, Minnesota. Two of the pools created here by the flood control and navigation dams have relatively stabilized water levels. These dams, which might easily have been so designed as to destroy most of the wildlife value of this great area are actually increasing these values. In the shallow portions of these stabilized pools, which lie outside the navigation channel, water plants, both the submerged aquatics and the emergent vegetation favorable to waterfowl and other marsh-loving birds, are establishing themselves in abundance.[10]

In a later book, Gabrielson pointed out that no single conservation organization could have benefitted wildlife so much as the Army Engineers had in their 9-foot channel project.[11] In 1939 the Corps of Engineers turned over 150,000 acres of overflow lands between Davenport and Lake Pepin to the Biological Survey for use as a wildlife refuge.

But of course, it was primarily for navigation that the 9-foot channel was developed, and here, too, the effects of the improvement began to show. Until 1946, because of the War, traffic remained relatively modest, averaging about 2,000,000 tons of freight per year. Then in 1947 the towboat *Alexander Mackenzie* took cargo of 18,500 tons up to St. Paul in one trip. By comparison, in 1857 the 22 boats that arrived at St. Paul brought 2,500 tons of freight. The *Alexander Mackenzie's* single load amounted to ½ the tonnage towed *annually* by the four packets of the Diamond Jo line between 1900 and 1910.

By 1950 freight passing through the Rock Island District had surpassed 5,000,000 tons; in 1959 the amount reached 10,000,000 for the first time. By 1972, the last year for which records exist, freight through the District exceeded 25,000,000 tons.[12] Traffic originating in the District or terminating there reached slightly over 6,000,000 tons during 1972.

The 9-foot channel has brought about changes not only in the amount of transportation but in the methods as well. Gone is the steam engine with its paddle wheel (a necessity

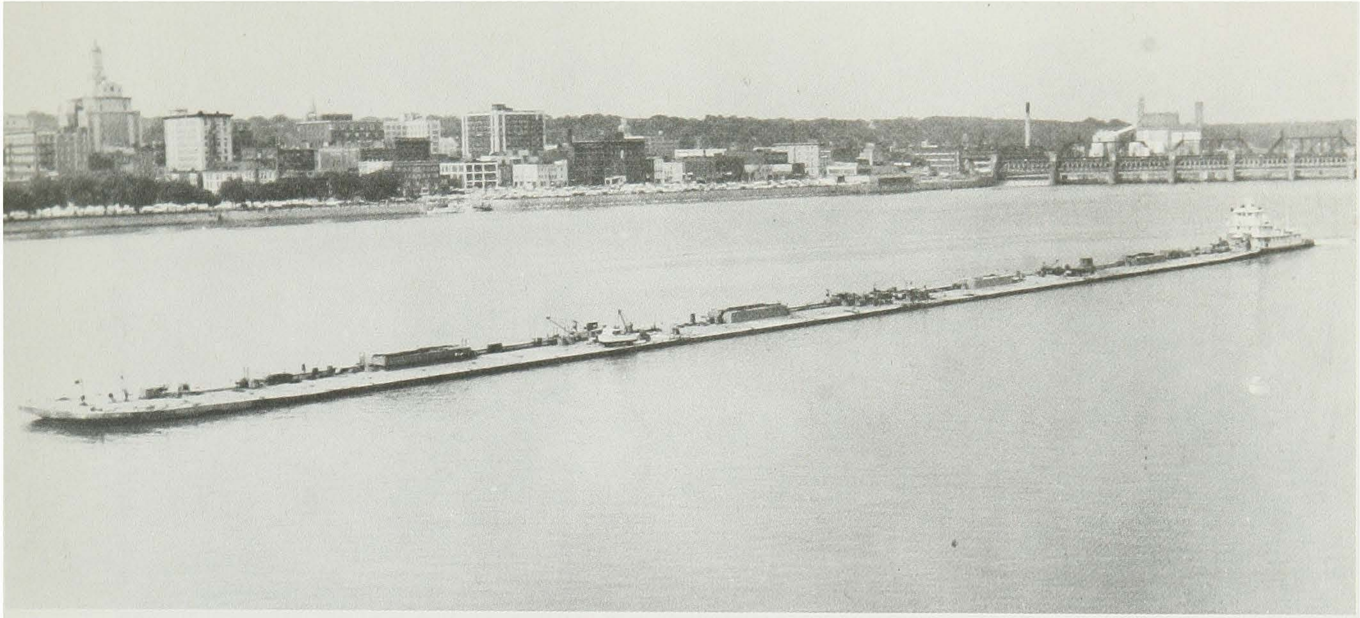


FIG. 57. Modern river traffic is far more sophisticated. Here the towboat *Winchester* is seen in Pool 16 with a $2,455,200.00 tow of linseed oil.

in the shallow water). In its place appear larger and larger diesel towboats. A typical modern towboat operating on the Upper Mississippi is around 165 feet long and perhaps 35 feet wide, with a draft of slightly over 8 feet and powered by as much as 5,000 horsepower.

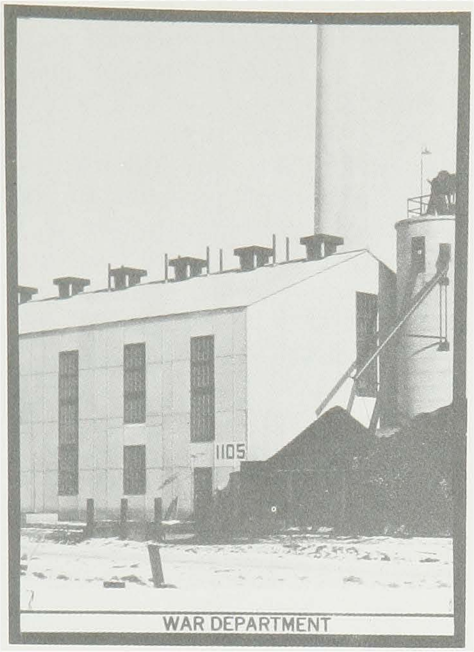
The standard barge which accompanies these towboats is 195 feet long, 35 feet wide, with an 8 to 9-foot draft. A barge like this can carry 1,500 tons of coal or grain, or up to 10,000 barrels (420,000 gallons) of petroleum products, or 45,000 bushels of grain. Each barge can carry the equivalent of 25 to 35 railroad cars. These barges are made into tows that may contain up to 15-17 barges, and often contain 12-14. In other words, a tow with 14 barges can carry the equivalent of 140 packet steamboats of the kind on the River in 1866, when the District began.

Along with an increase in traffic has come an increase in the number of terminals. In 1940 there were 4 terminals in the Rock Island District; by 1961 there were 70. There are no present indications that river traffic is levelling off. The 9-foot channel has done its job well.

FOOTNOTES

Chapter IX

1. Frank Fugina, *Lore and Lure of the Upper Mississippi River* (Winona, Minnesota: Frank Fugina, 1945), pp. 155, 302.
2. See, for example, Davenport *Democrat*, October 13, 1935. Also based on interviews with Corps employees Frank Ashton and Robert Clevenstine.
3. "Clock Tower," Rock Island District Information Pamphlet, p. 2, Rock Island Historical Files.
4. *Report of the Federal Civil Works Program as Administered by the Corps of Engineers U.S. Army, 1951*, Part 1, Vol. III (Washington, D.C.: Government Printing Office, 1952).
5. St. Louis *Post Dispatch*, July 19, 1939, p. 30.
6. Malcolm Elliott, "The Upper Mississippi River Project with a Discussion of the Movable Gates in the Dam," Paper read before the Western Society of Engineers, Chicago, November 1, 1937 (Typewritten). Also, *Upper Mississippi River Navigation Improvement, Providing a 9-foot Channel Depth between Minneapolis and the Missouri River* (St. Louis: Office of the Division Engineer, 1941).
7. Interview with Robert Clevenstine, June 21, 1973.
8. *Annual Report*, 1934, I, pp. 783-793.
9. *Annual Report*, 1935, I, pp. 1894-903.
10. Ira Gabrielson, "Floods and Wildlife," *Scientific American*, CLVI (February 1937), p. 101.
11. Ira Gabrielson, *Wildlife Refuges* (New York: the Macmillan Company, 1943), p. 193.
12. *Inland Waterways Journal*, Vol. 71 (January 27, 1973).




CHAPTER X

# MILITARY CONSTRUCTION

Completion of most of the work on the 9-foot channel and the coming of World War II slowed down civil works in the Rock Island District. Total expenditures for new work and maintenance in fiscal 1942 was $2,494,719.98. As with the rest of the Country, the District shifted to the war effort—specifically, to military construction.

Prior to World War II, building construction for the Army had been done by the Quartermaster Corps. It soon became apparent, however, that the Quartermaster did not have an ongoing, adequate organization to handle a sudden large increase in construction. Here is where the Corps of Engineers' involvement in civil public works made good military sense. Because of their work in the Nation's waterways, the Engineers had both the staff and experience to engage in large scale construction projects. Especially important was their long experience in working with contractors. The contractors knew the Engineers, and the Engineers knew which contractors could do which jobs.

Consequently, in 1940 all Air Corps construction and all work on the Atlantic island bases was assigned to the Engineers; on December 1, 1941, Congress assigned all military construction to the Engineers.

The Rock Island District adapted to military construction rapidly. During each of the war years, the District procured over 270,000,000 worth of supplies and equipment. During 1942 personnel at Rock Island designed and constructed more than $80,000,000 of military projects.

Most of this work was carried on by civilian personnel, but several District employees were commissioned into the Engineers and a number of reserve officers were transferred to Rock Island to supervise various aspects of construction. One of the employees was John Peil, chief of the planning section. In July 1942 Peil was commissioned as Major in the Engineers, and in February 1943 he was promoted to Lt. Colonel and reassigned as District Engineer for the duration of the War.

The first military construction by the Rock Island District was at the Rock Island Arsenal. Even before the War began, District engineers were making preliminary plans to expand certain facilities at the Arsenal to meet the increased needs of the Lend Lease program. A badly-needed new forge shop was designed and constructed prior to the War.

The first of the wartime projects at the Arsenal was an Administration Building, built in 1942. This was followed by a cafeteria con-

structed in a rehabilitated shop building, several underground machine gun testing ranges ( one used for development of the 70 caliber machine gun), and two new buildings, nos. 208 and 299.

Across the river in Bettendorf, Iowa, the Engineers took over a tank arsenal project begun by the International Harvester Company for the Ordnance Department. The plant was set up in the old Bettendorf Car Shop where a foundry and facilities for heavy equipment already existed.

In setting up this project, Engineers had to move the Bettendorf Company, which was making equipment for the Navy, to an Engineer-constructed building in Moline.

The few tanks produced at the Bettendorf Tank Arsenal were designed by the Rock Island Arsenal as part of a series which eventually led to design of the Sherman tank. The Bettendorf tanks, however, were made of riveted plate stock, and were reported to be very vulnerable by British troops who used them.[1] In addition, by the time the facility was finished, the Government had an excess of tank-producing plants, and production soon shifted to track personnel carriers.

The only World War II facility whose design and construction was supervised entirely by Rock Island District personnel was the Green River Ordnance plant at Amboy, Illinois, built in 1942-43. Although, as with all major military projects, the Green River plant was designed and built by contract from Government specifications, it required a large supervisory force for which an area office was set up at Dixon, Illinois.

Other major military construction projects supervised by the Rock Island District included Schick General Hospital at Clinton, Iowa. Schick Hospital, built from standard Medical Corps specifications, was the only hospital built by the District under wartime conditions. After the War, the District supervised construction of two hospitals for the Veteran's Administration at Iowa City and Madison, Wisconsin.

Additional military construction was performed by the Rock Island District at the Ordnance Proving Grounds at Savanna, Illinois. Here Engineers built several Igloos, semi-buried munitions storage buildings. District personnel also built the first WAC training camp in the United States at Fort Des Moines, Iowa. Here they refurbished several old buildings and added several new ones.

To reach all of these scattered military projects, the Rock Island District assembled a vehicle fleet numbering about 300 pieces, including 57 brand new 1942-model Pontiac and Chevrolet station wagons and sedans.[2]

In 1946 the District returned to civil works. Since then, military construction in this area has been carried out by the Chicago District and, more recently, by the Omaha District. The Rock Island District has remained entirely with civil navigation, flood, and recreation programs.

FOOTNOTES

Chapter X

1. Interview with Robert Clevenstine, June 21, 1973. This and other information in this chapter comes from brief District records, but primarily from Robert Clevenstine and Frank Ashton, both now retired, who were in charge of various aspects of military construction during World War II.

CHAPTER XI

# FLOOD CONTROL

The river belongs to the nation,
The levee, they say, to the state;
The government runs navigation,
The commonwealth, though, pays the freight.
Now, here is the problem that's heavy—
Please, which is the right or the wrong?
When the water runs over the levee,
To whom does the river belong?[1]

Floods, or freshlets as the 19th century population of the Mississippi Valley called them, have been a perennial problem. On the lower river such floods, carrying water from tributaries that form a drainage basin stretching from Glacier Park in Montana to northern New York, once overflowed natural levees left by silt from the flooding river into thousands of acres of lowlands. To prevent flooding here, natural levees were heightened. Along the Mississippi north of St. Louis, however, the problem is different. Here both farm land and towns are squeezed in narrow strips of bottom land which ends abruptly with high bluffs. There is no wide flood plain to spread the water out. Urban areas here become particularly vulnerable to flooding.

For some reason, floods along the Mississippi seem to have come in cycles, or "wet decades." Periods of high water seem to alternate with years of unusually low water. Wet decades occurred in the 1820's, the 1840's, the 1880's and the 1940's. Another wet cycle seems to have begun in the mid-1960's, continuing into the early 1970's. So far in this last period, two of the worst floods on record have occurred.

Floods along the Upper Mississippi are quite different from the spectacular gully washers of the Western states or the floods along deep narrow valleys such as that at Rapid City, South Dakota, in 1972. These raging floods can splinter trees and wrap cars into knots. They sweep away lives and give dramatic evidence of their awesome powers.

A Mississippi flood is comparatively quieter and more ponderous. Weeks ahead of time the Weather Bureau, with the assistance of the Corps of Engineers, is able to predict with fair accuracy the probability of a flood. Days ahead of time they can predict the arrival of the crest within hours and the flood stage within inches. Newspapers, radio, and television follow the crest down river, and as it arrives at each of the towns it becomes a social event. Townspeople

turn out along the waterfront to watch the water slowly inch up the street.

This makes a Mississippi flood seem different from other natural disasters. Tornados and blizzards show their violence, but a flood hides its destruction under a disarmingly calm surface. The current eating away a foundation is not so visible. It is hard to imagine that millions of dollars of damage are being done while children ride bicycles down streets covered by inches of water.

But the leisurely pace of the flood is deceptive. Bit by bit foundations crumble, water supplies are contaminated, belongings ruined, farmlands made useless for the coming season. As the flood wears on, time is lost at factories, roads wash out and buckle. For those directly involved, and indirectly for the taxpayer, a flood is expensive. And they become more expensive with each year as populations and industry increase along the Valley.

*Early Flood Control Work.* Combatting floods was at first left in the hands of individual residents. South of the Ohio River early in the 19th century, owners of land along the river's edge were responsible for constructing and maintaining levees along their own portion of land, putting all the burden on them and none on landowners further inland who benefitted as much. When this practice proved unworkable, the concept of levee districts developed. These districts included all threatened residents within an area which could be protected by a single levee. Residents in towns further north built their houses on stilts, sought high ground, or, if they were true river rats, lived with the problem, expecting to move furniture up to the second floor every few years.

In spite of the need for more systematic flood control planning than could be carried out by small groups, the Corps of Engineers did not become involved in flood control in a major way until the Flood Control Act of 1936 put the responsibility for such control with the Engineers.[2]

Prior to this such flood control as the Rock Island District engaged in was piecemeal and often disguised as "navigation improvement." The Corps had on occasion aided flood victims. In the spring of 1882 during the disastrous floods south of St. Louis, the *Barnard* and the *Coal Bluff*, along with personnel from the District, went south with supplies. But even this emergency relief needed to be authorized by a Congressional resolution. Primarily, the Corps remained limited to its single-purpose navigation projects.

The first break away from single-purpose navigation projects came in 1879 when Congress established the Mississippi River Commission. The Commission consisted of seven members: three appointed from the Corps of Engineers (one of whom was to serve as president), three from civil life, and one from the United States Coast and Geodetic Survey. In the Act of June 28, 1879, establishing the Commission, Congress directed that they survey the river and develop plans which would "correct, permanently locate, and deepen the channel and protect the banks of the Mississippi River; improve and give safety and ease to the navigation thereof; prevent destructive floods; promote and facilitate commerce, trade and the postal service."[3] Further, Congress gave the Commission power to initiate plans.

Originally, the Commission's jurisdiction over surveys and investigations extended to the headwaters of the Mississippi, while jurisdiction for construction work was limited to the Lower Mississippi, from the mouth of the Ohio to the Head of the Passes. It jurisdiction was extended from time to time until by 1926 it had control over construction of flood control works on the main River to Rock Island, and on the tributaries for as far up as they influenced floods on the main River.[4] All of the construction work supervised by the Commission was detailed to the Engineers.

For the most part, however, the Mississippi River Commission concentrated its efforts south of the Ohio River. It did investigate the possibility of using reservoirs on the Upper Mississippi tributaries as a means of flood control. Had they determined on this method of improvement, the Rock Island District might have been in the flood control business much earlier. However, the Commission rejected reservoirs as too expensive in 1927 and decided on levees as the primary method of control.

In the early years of improvement work, the Rock Island District took its limitation to navigation problems seriously. In 1884 people in the Sny Drainage District south of Quincy, Illinois, who had built a 50-mile levee requested reimbursement from the Government on grounds that the levee, by keeping the water within the channel, aided navigation. Colonel Mackenzie was requested to examine this levee to see if it qualified. He reported that it had neither hurt nor helped navigation, and the request was denied.[5]

Within 10 years, however, the increasing

encroachment of the river bottoms by agriculture, industry, and population heightened the need for flood control. Both the Corps and Congress softened their positions. In 1895 the Rock Island District embarked on its first flood control project, the Flint Creek Levee.

The River and Harbor Act of August 18, 1894, provided for a survey along the west side of the Mississippi River from Flint Creek to the Iowa River "with a view to improving the navigation by preventing the water from overflowing the natural and artificial banks along those parts of the river and deepening the channel."[6]

The same Act directed Colonel Mackenzie to make a survey of existing levees between Warsaw and Quincy, Illinois. This was a series of three levees comprising the Hunt, Lima Lake, and Indian Grave drainage districts built between 1881 and 1888. Recent floods had seriously weakened and breached these levees, and disagreements between the levee commissioners had allowed them to deteriorate.

Over the next two decades the justification of levees as navigation improvements was used again and again in Congressional directives to the Corps of Engineers, though it was evident that in water high enough to flood, no levee was needed to deepen the channel for boats.

In 1895 Congress appropriated $85,000 to repair and raise the levee from Quincy to Warsaw to 3 feet above the high water of 1892. The same Act appropriated $300,000 to construct a 35-mile levee between Flint Creek and the Iowa River. This was an earth levee with a slope of 3 to 1 on the river side and 2 to 1 on the land side, with a 4-foot width at the crown. The Flint Creek Levee was the first and only levee built by the Rock Island District without cost to local interests.[7]

These levees were simply built of earth removed from borrow pits on both river and land sides of the levee. The borrow pits were situated beyond a 20-foot shelf on which the levee sat, but within the 100-foot strip of land owned by the levee district. Levees averaged seven feet high. Where they were subject to the action of current or waves, they were revetted; elsewhere grass and weeds made a thick mat. The only equipment used was scrapers.

More complicated problems arose over drainage of water impoundedd behind the levees when the river reached flood stage. For this, pumping stations and holding ponds were built. This was not much of a problem since both of the levee projects in 1895 were in rural areas.

Following these two levee projects, the Rock Island District did very liittle flood control work for the next 30 years, aside from a small amount of work on drainage problems caused by the pool behind the Keokuk Power Dam. Not until the disastrous flood of 1927 did the Corps become active in outright flood control.

The 1927 flood dramatized the Engineer's inadequate program of improving navigation on main streams while overlooking the tributaries. An argument had been building among various groups over the best method for dealing with floods. Some groups wanted levees, others wanted dams, yet others wanted reservoirs. Out of this confusion, precipitated by the flood, grew the River and Harbor Bill of 1927 in which Congress authorized comprehensive examinations and surveys of the inland waterways by the Corps of Engineers to formulate

> general plans for the most effective improvement of navigable streams and their tributaries for the purpose of navigation and the prosecution of such improvement in combination with the most efficient development of the potential water power, the control of floods, and the needs of irrigation.[8]

These were the famous "308 reports" which became the point of departure for most basin-wide, multi-purpose water resources planning in the United States. The TVA Act of 1933 made that the pilot basin based on those surveys.

Following the 1927 flood, the Mississippi River Commission requested the Rock Island District to assist with levee rehabilitation as far north as Rock Island. These were the first flood control projects in the District which did not come under the guise of navigation improvement.

In 1936 the Flood Control Act of June 22 put flood control more definitely under supervision of the Corps of Engineers. This Act is usually considered the beginning of full-fledged flood protection work by the Corps. This same Act put responsibility for water flow retardation and soil erosion prevention under the Soil Conservation Service of the Department of Agriculture.

The Flood Control Act of 1936 authorized 14 individual flood control projects in the Rock Island District. Most of these were in agricultural drainage districts downstream from Rock Island, and included work at Keithsburg, Henderson, South Quincy, the Sny Island Levee District, and the Rock River Basin. Congress did not authorize money for these projects, however, and no actual work was done.

In the Act of 1936 Congress formally adopted benefit-cost analysis as a means of determining

feasibility, although this had long been an informal policy for earlier Engineer projects. Section 1 of the Act stated:

> The Federal Government should improve or participate in the improvement of navigable waters or their tributaries, including watersheds thereof, for flood control purposes if the benefits to whosoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected.[9]

Little work was done in the next two years, with only $4,000 of work in the District to 1938. But with the Flood Control Act of 1938, flood protection was on its way to becoming the main activity of the Rock Island District. That act included the first provisions for Coralville Reservoir.

*Reservoirs.* The idea of controlling the flow of the Mississippi River by a series of reservoirs on the tributaries has been a recurring idea since the 1850's when Abbott and Humphreys investigated that possibility as part of their hydrographic survey. Major G. K. Warren suggested the use of reservoirs above Minneapolis, not for floods, but to increase the flow of the river between Minneapolis and Lake Pepin during the low water season. Five of these reservoirs were built in 1882-83, and were partially successful in increasing the water level for 40 or 50 miles below St. Paul. Humphreys, however, continued to oppose reservoirs, and his successors followed him in considering them either too expensive or unnecessary.

If the main stem of the Mississippi had been the major cause of flooding, perhaps reservoirs would have remained too expensive. But flood problems in the Upper Mississippi Valley came as much from the tributaries as from the Mississippi. The Rock, Iowa, and Des Moines Rivers were capable of causing extensive flood damage to towns and farmlands along their own banks. Also, seasons of extremely low water on rivers such as the Des Moines reduced the water flow so much as to affect water quality, fish and wildlife, and industrial and recreational use of the streams. On such streams, reservoirs would be of benefit during low water as well as during floods.

In a comprehensive plan for flood control, the Flood Control Act of 1938 authorized $2,700,000 for local flood protection on the Mississippi and Illinois Rivers, and $6,600,000 for reservoirs. The Act specifically made provisions for a reservoir at Coralville on the Iowa River north of Iowa City, as one of the projects selected and approved by the Chief of Engineers. The estimated cost was $4,999,000.

Extensive field surveys began at a tentative site in 1939 to determine land damages and remedial work, and to collect data for general hydraulic, hydrological, economic and flood routing studies. District engineers drew the first plans during 1940. They provided for construction of an earth fill dam, 1,400 feet long at the top, rising approximately 95 feet above the stream bed, with a reservoir providing for controlled storage of 400,000 acre-feet. An outlet works was to be located adjacent to the left abutment, with a controlled spillway on the right abutment. Discharge from the spillway (which would occur only in extreme floods) reentered the river 900 feet downstream from the toe of the dam. $146,163 was spent on the project in fiscal 1940.[10]

World War II brought civil works in the District to a standstill before any actual construction had begun at Coralville. Throughout the War only minor attention was paid to the project. In 1944, engineers considered alternate sites; in 1945 $29,000 was spent for surveys and reports (the largest single item of any civil project in the District in 1945). By the time construction began in 1948, the revised cost estimate had reached $14,089,000.

Meanwhile, District personnel were involved in flood fighting during major floods on the Des Moines River in 1944-45-46. The Flood Control Act of 1944 expanded District flood activities in several directions.[11] It authorized the creation of Red Rock Reservoir on the Des Moines River south of Des Moines. This reservoir, with a total capacity of 1,200,000 acre-feet, was substituted for one projected earlier at Howell. The 1944 Act also authorized the first major urban flood control project in the Rock Island District: improvement of the Des Moines River through the City of Des Moines. The Act appropriated $10,000,000 for flood control in the Upper Mississippi Basin, including the Red Rock project.

The Flood Control Act of 1944 authorized the Corps of Engineers to provide for recreational facilities at its projected sites and to contract for the sale of surplus water for domestic and industrial purposes. This latter provision primarily affected the arid and semi-arid Western states, but from the statement on recreation has come a wide variety of camping, fishing and boating facilities at Corps' reservoirs.

The 1944 Act made one important change in procedure; it required the Corps to submit proposed project plans to each affected state for official review.

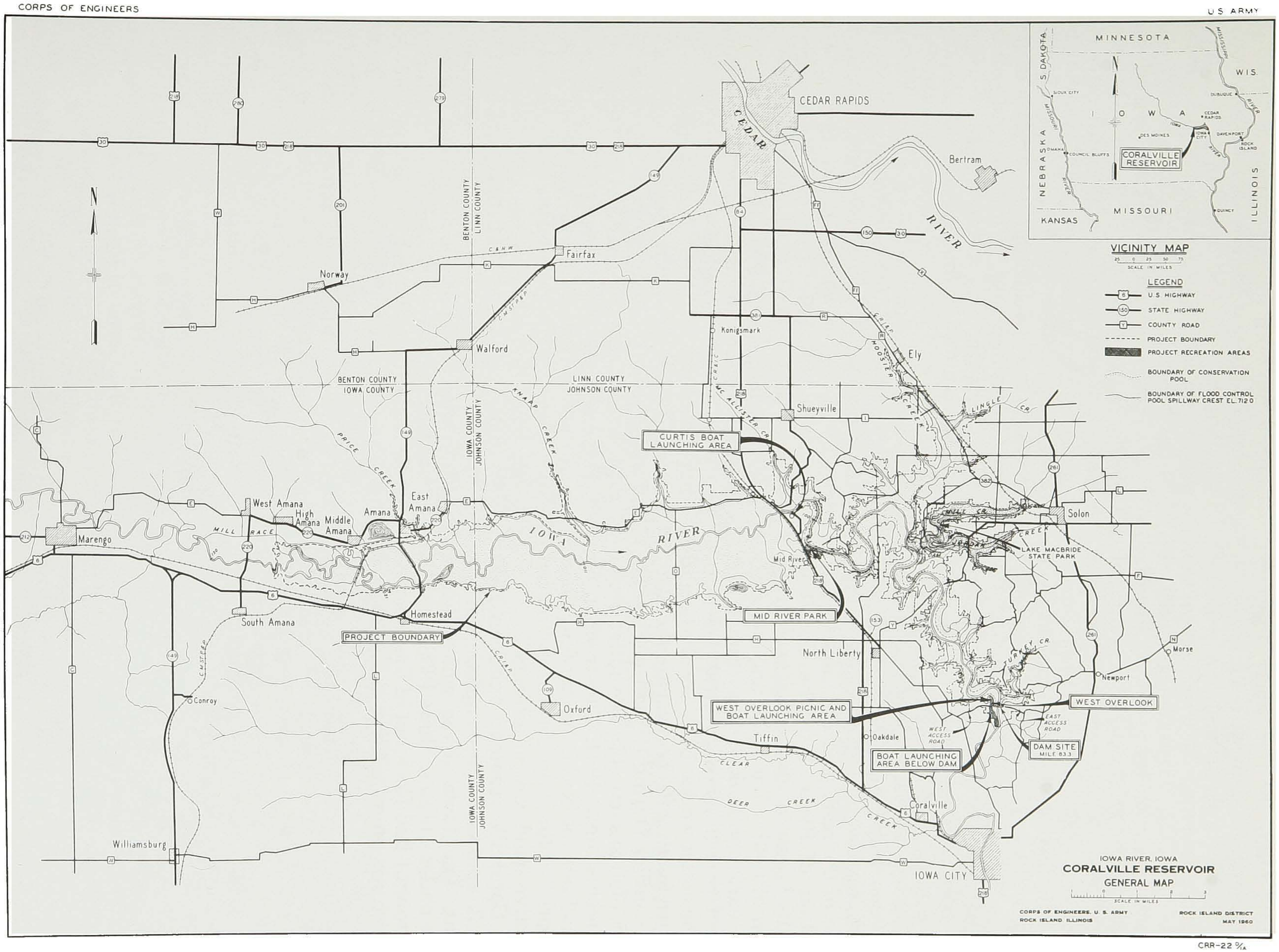



FIG. 58. A map of the extensive Coralville Reservoir project, first of the flood control reservoirs constructed by the Rock Island District.

The original plans for Red Rock Reservoir called for an earth-fill dam with a crest elevation of 814 feet above sea level and a length of 1,000 feet. In accordance with provisions of the 308 Reports of 1927, engineers planned a powerhouse with a capacity of 8,600 kilowatts as part of the project. Of the planned volume of 1,200,000 acre-feet, 800,000 were designated for flood control and 400,000 for power and recreation. The estimated cost of the project was $20,710,000. By 1948 this had risen to $53,000,000.

In 1946 Congress, continuing its growing interest in inter-agency cooperation, gave the Fish and Wildlife Service broad powers of consultation where alteration of natural stream conditions was contemplated.[12] District personnel have worked with this group during construction of the reservoirs and afterwards.

Construction of Stage 1 of the Coralville project finally began in 1949 with site clearing, construction of field office buildings, and erection of the earth embankment portion of the dam. Stage 1 was finished by 1950 and work began on the outlet works. Both Coralville and Red Rock then felt the effects of yet another war, the Korean conflict. During 1953-54, civil works in the District fell to a low ebb. The outlet works were not finished until 1954. Construction on Red Rock had not yet begun and no funds had been appropriated for it. In 1954 it was placed under "inactive flood control projects."

Work on Coralville resumed again in 1955 with Stage 3, spillway and completion of the embankment. The Iowa River was diverted through the outlet works in June 1956. In 1956 Congress brought Red Rock out of the inactive category with an appropriation for planning funds.

Coralville Reservoir was completed early in 1958 and began operations for flood control in February. That same year, the Flood Control Act of 1958 authorized planning for a supplemental flood control reservoir on the Des Moines River upstream from Red Rock Reservoir, about 11 miles above Des Moines. This was Saylorville Reservoir, for which preliminary planning began in October of 1959.

The first construction money for Red Rock was appropriated in 1959. By now estimates for the project had reached $75,200,000. Model tests of the spillway were made at the U.S. Army Waterways Experiment Station in Vicksburg, and construction began in the summer of 1960.

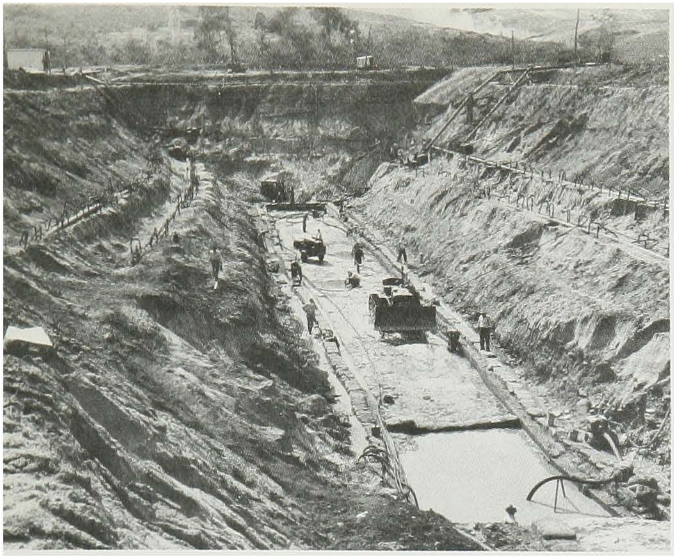
From this time on, work on Red Rock continued steadily until it was completed in 1969. Contractors built an impervious earth-fill embankment 110 feet high and from 680 feet wide at the base to a crown width of 44 feet. At the same time, extensive work went on to acquire the necessary land for the lake and to relocate people and structures. 47,000 acres were purchased for the project. Within this area, portions of two towns and an unincorporated community had to be relocated above the flood control pool. In addition, the project necessitated the relocation of 42 miles of state and county highways, 96 miles of railroad, 255 miles of electric power and telephone lines, 2 miles of natural gas line, and eight cemetaries.

Red Rock Reservoir was completed on schedule in the summer of 1969 and dedicated on September 5-7. Unexpectedly, those attending the dedication saw Lake Red Rock at full elevation. An extremely heavy flow in mid-August had filled the Reservoir to its permanent level of 725 feet above sea level in three days.[13]

The permanent lake of 8,950 acres created by the dam is one of the largest lakes in Iowa. At its full flood pool elevation of 780 feet, this is increased to 65,500 acres. At this stage the lake extends 33.5 miles upstream to the south limits of the City of Des Moines. The final cost of Red Rock Reservoir was about $85,000,000.

Red Rock Reservoir serves three purposes. Its major use is to control floods on the Des Moines River below the dam and on the Mississippi River below Keokuk. Three severe floods on the Des Moines River in 1944, 1947, and 1954 had caused 51 million in damages to towns such as Ottumwa, Eddyville, and Eldon, and to thousands of acres of farmland. During low water stages, usually in late summer, Lake Red Rock is used to maintain a flow of 300 cubic feet per second at Ottumwa. By contrast, during the low water of 1940 this rate had fallen to 30 feet per second. Maintaining a more even flow of water aids water quality and enhances fish and wildlife. Even though Red Rock's third purpose, recreation, is not yet fully developed, thousands of people visit each year to swim, fish, boat, and camp. Wildlife also benefits from the project. Together with the Iowa Conservation Commission and the Bureau of Sport Fisheries and Wildlife, the Corps of Engineers is developing large portions of the project lands for intensive waterfowl management.

The original plans for Saylorville Reservoir in 1960 estimated the project at $49,500,000. The plans called for a rolled earth embankment 6,050 feet long extending from bluff to bluff across the valley floor of the Des Moines River,



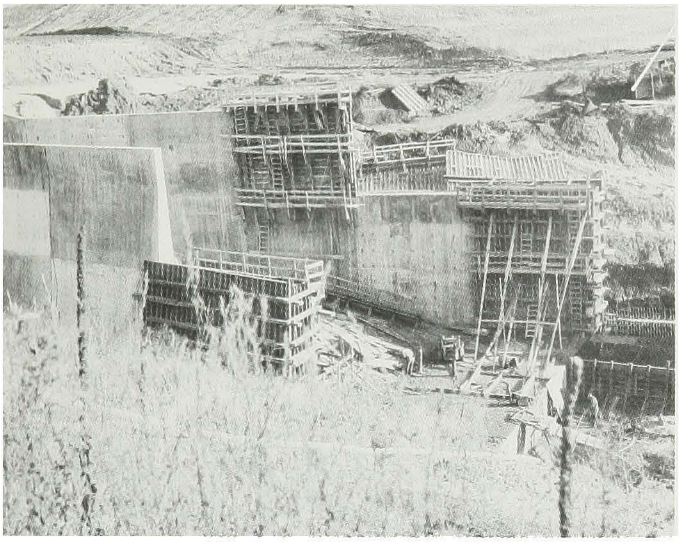


FIG. 59. The beginning of dam construction at Coralville Reservoir.

FIG. 60. Riprap operations on the upstream slope of the Red Rock Reservoir dam.

FIG. 61. Construction of the outlet works and spillway at Saylorville Reservoir.

FIG. 62. An overview of the completed facilities at Coralville Reservoir.

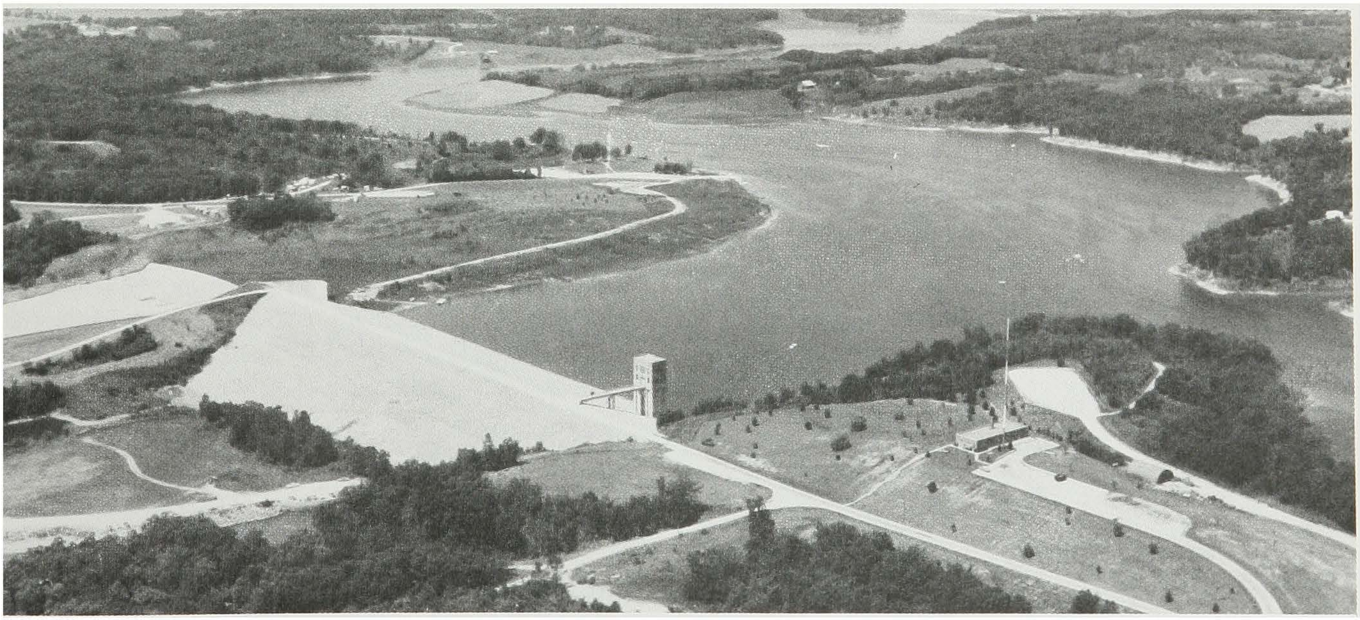



FIG. 63. In addition to their primary purpose of flood control, the reservoirs in the District serve a variety of recreational interests.

at a maximum height of 125 feet. The outlet works consisted of 4 16-foot concrete conduits through the base of the dam, and a control tower from which gates in the conduits will be controlled. This was later changed to one 22-foot diameter conduit with 3 electically operated gates in the tower.

Engineers planned a spillway west of the embankment in the form of a concrete weir 400 feet long. Flood waters passing over the spillway are designed to flow down a paved chute to a concrete stilling basin, then through an excavated pilot channel to the river.

Saylorville was designed to hold the flood waters of a 5,823-square mile watershed. At peak capacity, it will contain 600,000 acre-feet of water.

Construction of the earth dam at Saylorville began in 1965. The spillway and outlet works were completed in 1970. The project was originally scheduled to be completed in 1975. But in 1972, before the last stage, completion of the earth embankment, was begun, growing conservation and ecological concerns caught up with the project and had it halted by the courts pending completion of an environmental impact study. Such studies are now a standard part of all preliminary surveys and examinations by the Corps, but Saylorville was begun before such studies became common. Environmental interests were especially concerned with the impact of the flood waters in the lake on Ledges State Park at the north end of the project.

As per court order, District personnel had completed a final environmental impact statement, and work at Saylorville has resumed. When completed, Saylorville Reservoir will be a 5,400 acre lake. In addition to serving as a supplement to Red Rock in protecting towns and land downstream from both floods and low water, the project will give a great deal of protection to the City of Des Moines through which the river flows.

Several other sites for reservoirs have been examined over the past years, but the only remaining reservoir in the planning stage is on the Skunk River north of Ames, Iowa. This project was placed in an inactive category in June 1974 because of state and local opposition.

*Other Flood Control Measures.* Following heavy floods in the spring of 1943 and again in 1944, Congress authorized a total of $22,000,000 to be appropriated as emergency funds disbursed by the Secretary of the Army and the Chief of Engineers for repairs, restoration, and

strengthening of levees and other flood control works threatened or weakened by floods. Of this sum the Rock Island District received just over $350,000 for levee repair in 1944, and $749,461 for 47 levee repair projects in 1947. These funds were supplemented by $12,000,000 in 1945 and $15,000,000 in 1947. Funds from this appropriation do not need prior approval for each individual project, and are in addition to regularly authorized projects. Under this appropriation, the District continues to undertake several emergency projects each year. These may involve work during a flood or repair to flood control or navigation structures caused by the flood.

Projects constructed from regular appropriations have primarily been the construction or the bringing up to grade of rural and urban levee protection systems. By far the largest of these projects was the Sny Basin, authorized by the Act of July 24, 1946. Its estimated cost in 1946 was $6,477,000, but its final cost when it became operational in 1967 had risen to $13,822,605.[14]

The Sny was a former by-channel of the Mississippi in Pike, Adams, and Calhoun Counties, Illinois. The project was for reduction of interior flooding through a comprehensive system of retarding reservoirs, diversion channels, pumping stations, closing levees, and drainage culverts and aqueducts.

Work on this project was slow in starting and was slowed even further by the reduction of expenditures during the Korean War. But in 1954 Congress authorized construction or modification of 14 rural levee protection projects within District boundaries. These projects downstream from Rock Island involved 335 miles of levee construction to protect 325,000 acres of agricultural lands along both sides of a 200-mile stretch of the Mississippi River. All of these projects are complete. Others of a similar nature have been authorized on both the Mississippi and many of the tributaries.

The first major urban flood control project was protection of the City of Des Moines from the Des Moines and Raccoon Rivers within city limits by construction of levees and floodwalls. This project was authorized by the Flood Control Act of 1944, but construction did not begin until 1966. The project is now virtually complete.

A second major urban flood control project was authorized at Dubuque by the Flood Control Act of 1962. Situated on a narrow strip of land between the river, with bluffs stretching the whole length of the city, Dubuque was in many ways ideally located for flood protection. But urban flood protection is a far more complicated problem that that posed by rural levees. Dubuque was not only a dense urban area, it was still a community tied to the river. The Dubuque Ice Harbor was still used for industrial, commercial, and pleasure use. In other places along the waterfront, industries depended on the river for their operation or had constructed buildings too close to the water's edge for a levee. In addition to sections of earth levee, the Dubuque project involved concrete and steel walls, closure structures, a navigation opening for the commercial harbor, and interior drainage facilities.

Construction of the Dubuque levee began in 1968 after careful planning and testing by the Engineers and the contractors. The project was completed in early spring of 1973 in time to show dramatic results in protecting Dubuque from the devastating 1973 flood.

By 1966 similar, though lesser, projects had been completed at 8 cities and towns throughout the District. Several others are now nearing completion; still others remain in the planning stage due to lack of funds or indecision by city governments over the best method of flood control.

In addition to local flood protection projects, the Corps of Engineers also performs several other flood related services. Engineers are available on request from communities to serve as advisors during flood fighting activities. The Corps also maintains an information service to keep local news media up to date on flood information before, during, and after the flood.

The Flood Control Act of 1960 authorized the Corps of Engineers to develop and provide information about flood hazards to states and communities. The purpose of these flood plain information studies is to aid local governments in regulating flood plains so as to avoid or minimize future damage. A state or other responsible governmental agency must request these studies and agree to disseminate the final report, and the application for a study must be approved by the Chief of Engineers before the surveys and examinations can be started. More than 20 of these studies have been completed.

*Procedures for flood control projects.*[15] The procedure by which a community obtains a flood control project is a complicated and long one. Critics of the Corps are fond of suggesting that Corps of Engineers, looking for work to do,

intrudes on community affairs in order to build levees. In fact, just the reverse is true.

The process which ends with a levee on the waterfront begins with a request from the people with the problem. Community officials, through their Senator or Representative, request help with their flood problem. The Congressman, in turn, introduces a resolution into the Public Works Committee of the House or Senate calling for the Corps of Engineers to study the feasibility of providing flood protection.

From this point until the levee is actually built is a complicated process taking an average of about ten years, much longer if there are problems of funding or difficulty in obtaining community consensus. The process involves community meetings, several studies and reports, investigations of alternate possibilities and of such factors as impact on the environment, social acceptability, and the effect of the project on national and regional economy. The illustration on page 251 sketches the process.

## FLOODS

Record-breaking floods occurred on the Mississippi River in 1951, 1965, and 1973. A comparison of these illustrates how different Mississippi floods can be. The wide drainage basin of the Upper Mississippi provides a range of factors which can form different combinations to cause floods.[16]

*The Flood of 1951.* In an area as large as that of the Upper Mississippi Basin several conditions must coincide for major flooding to occur. Such a set of conditions occurred in April and May of 1951, resulting in a flood that exceeded the previous record flood of 1880 at nearly every location from Dubuque to the lower limits of the Rock Island District.

Warm weather toward the end of March combined with six major and several minor rainstorms throughout the District between April 1 and May 18 provided a prolonged period of flood stage on most of the upper Iowa and Illinois tributaries.

However, these conditions merely set the stage for the major contributing cause of the 1951 flood, a heavy snow melt during April from the central portions of Minnesota and Iowa. March was a wet month over the entire Minnesota River watershed, with an average 36 inches of snowfall, compared to a normal fall of 8 inches.

Although the spring break-up during the second week in April did not extend up the Mississippi beyond the mouth of the Minnesota River, the melt in central Minnesota was rapid. The resulting flood on the Minnesota River was the most disastrous flood in that State's history. Especially hard hit was Mankato, where the crest flow was about 50% greater than the previous record flow. In Wisconsin, the St. Croix, Chippewa, Black, and Wisconsin Rivers contributed to the flood.

By April 15, severe flooding was forecast in the Mississippi Valley. Water coming down the Mississippi, combined with the April ice breakup, and the water from storms and swollen tributaries created a record flood.

The crest of this flood reached the upper end of the Rock Island District on April 21, and Dubuque the next day. At Dubuque the river stayed close to the crest level for 5 days. As the flood moved downstream, the crest lengthened, remaining at Rock Island for 9 days, at Burlington for 14 days, and at Quincy for 16 days.

The seriousness of the flood became apparent about a week before it arrived. During this time the Corps participated in flood prevention measures. Mayors, representatives of business and industry, and others interested were invited to meetings at Dubuque, Clinton, and Rock Island where representatives of the Corps discussed the impending flood.

Technical personnel from the Rock Island District were stationed in problem areas throughout the District during the critical flood period to give advisory assistance on emergency flood protection. In addition to the regular work force at the District Office who performed flood fighting as part of their normal work, 65 additional men participated in the District's activities.

The Corps assisted in many other ways: collecting rainfall, weather, and river stage information for local authorities; informing the Coast Guard, Red Cross, and other agencies of flood conditions, patrolling levees and other trouble spots. In addition, the District procured flood fighting equipment from its stock of materials. These included 375,000 sandbags. The total spent by the Corps on these emergency activities was $110,000.

Following the flood, the District made field observations of damages. Property and wage loss was particularly severe in the urban areas.

# THE MECHANISM BY WHICH RIVER AND HARBOR AND FLOOD CONTROL PROJECTS ARE CONCEIVED, AUTHORIZED, AND CONSTRUCTED

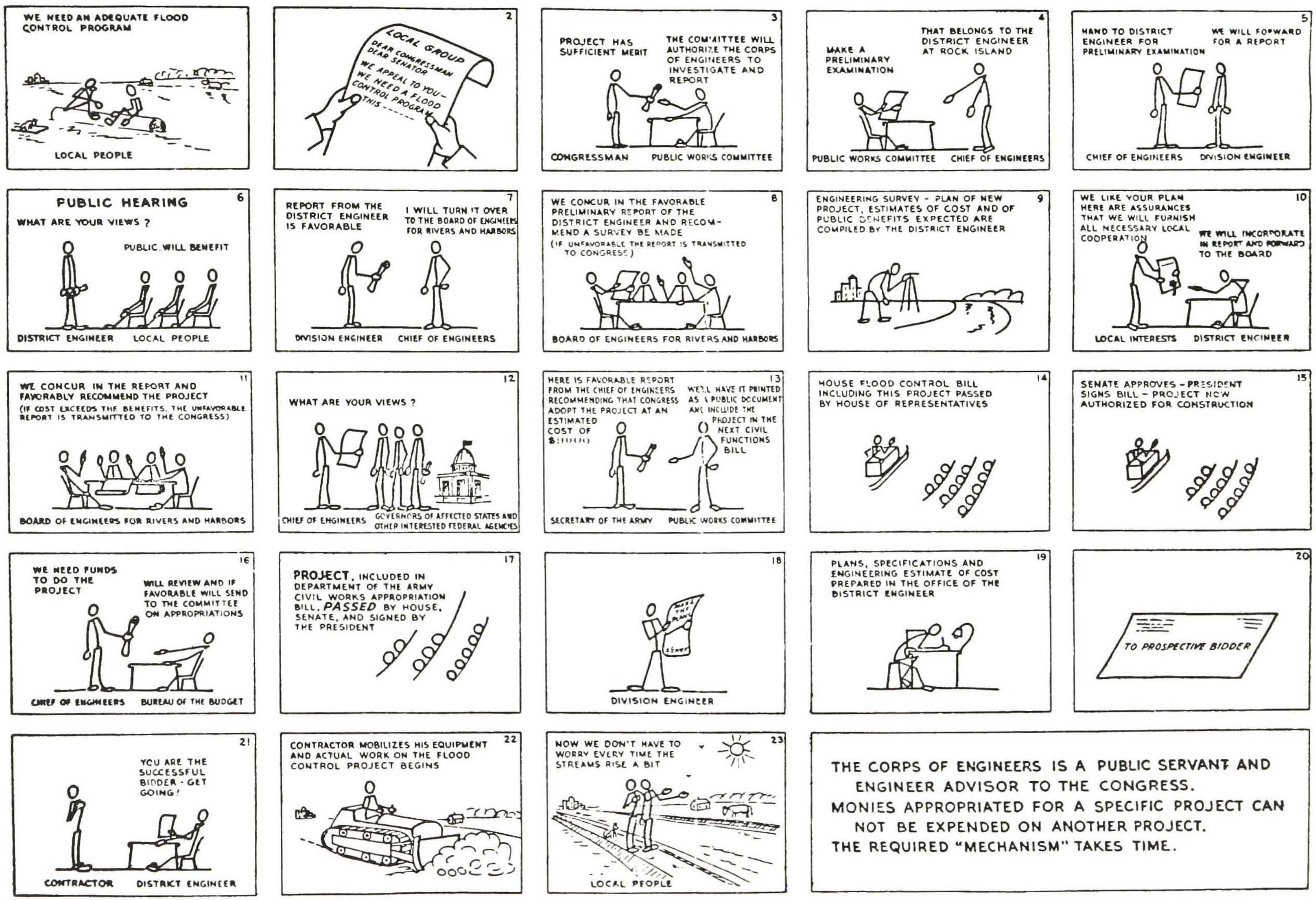



FIG. 64. A chart showing the steps necessary for a city or rural drainage district to obtain a flood control project.

FIG. 65. Front Street in Davenport during the 1888 flood.

Although the flood inundated many acres of farmland in the southern part of the District, it came at a time when there was little loss to crops and only a slight delay of the planting season.

Several communities along the main stem of the Mississippi were hard hit, but nearly everywhere, existing flood protection works and additional emergency construction prevented even more serious damage. Towns like Dubuque where the flood stage exceeded the 1880 record by 1 foot could have been hard hit, except for hard work constructing temporary dikes. Industries installed pumps and moved equipment to upper levels. While Dubuque experiences flooding of some low-lying residential areas, and had problems with its sewer system, damage was far less than it might have been.

The story was the same downriver. Only in locations where levee systems failed was there extensive damage. Two island communities at Campbell's and Smith's Islands had to be evacuated.

The Rock Island District's after-flood report put the total damages in the District, both rural and urban, at $9,403,900 along the Mississippi River, with another $775,035 of damages along the tributaries. While 4,917 persons were displaced for shorter or longer periods of time, advance warning helped keep the loss of life to 1, a drowning at Des Moines attributed to the flood.

An estimated $18,960,730 of damages were prevented by the advance warning and another $13,851,400 in damages was prevented by flood control projects—mostly rural levee systems—within the District.

*The 1965 Flood.* Less than 15 years after the record flood of 1951 the Mississippi Valley experienced an even more memorable flood. The flood of 1965 was one of the severest on record from the headwater area of Minnesota to the confluence of the Illinois and Missouri Rivers.

Several factors again combined to cause the flood. Upstream areas of the Mississippi Basin received above normal rainfall in August and September of 1964. The ground was wet when the winter freeze-up occurred. In December the weather grew cold, causing deep frost penetration and rendering the ground impervious to the

FIG. 66. Clinton, Iowa, during the 1951 flood.

spring's melting snow and rainfall. Rain in February and above freezing temperatures during the month increased the water content of the snow cover. Finally, above normal snowfall occurred during March over the whole basin. The Weather Bureau at St. Paul recorded a total snowfall of 73 inches, compared to an average of 45-50 inches.

By the end of March it was apparent that a flood was coming. On March 31 the Rock Island District prepared a flood potential report. The impending flood was given wide coverage by the news media and once again, the Mississippi Valley began preparatory measures. During the first week in April the Corps established communications with threatened communities. A 24-hour surveillance was established and around-the-clock construction was begun at critical sites. As with the 1951 flood, District technical personnel were sent to critical areas.

As the flood crest came down the river through the Rock Island District, it attained record levels over almost the entire length of the Mississippi. The crest exceeded the previous maximum at Guttenberg, Iowa, by about 4 feet. At Dubuque the river rose above flood stage on April 1 and remained above until May 11. At Rock Island the crest stage reached 22.5 feet, 3.1 feet above the previous record level.

Because of the record amount of flood water, the flood stage lasted longer than the 1951 flood. The duration of flood stage went from 26 days at Dubuque to 43 days at Hannibal, Missouri.

As with the 1951 flood, much damage was prevented by advance warning and preparation. However, with the water at stages significantly higher than those in 1951, problems were more serious and greater damage resulted. At Cassville, Wisconsin, where 5 homes had been touched by the 1951 flood, 69 residences were affected in 1965, forcing evacuation of 220 persons. At Dubuque, even though a 3.5-mile dike was constructed after the flood warning, extensive property damage occurred. The cost estimate for industrial and residential property in Dubuque was $2,060,000 in physical damage alone, with the total cost of the flood in lost wages, property damage, and flood fighting put at $7,654,000.

The story was repeated downriver: damages to streets, storm sewers, problems with sewage disposal, interruption of railroad service, dislocation of families. Towns like Fulton and East Moline, Illinois, experienced serious damage. At East Moline 958 homes were partially destroyed and 2,537 persons had to be evacuated.

Only a few locations escaped with minor damage. Examples were Bellevue, where precautionary measures were taken, and Galena, Illinois, and Sabula, Iowa, where Corps

FIG. 67. Fulton, Illinois, during the 1965 flood, one of the worst floods in the District.


FIG. 68. Main Street in Hannibal, Missouri, during the 1965 flood.

of Engineers' local protection projects successfully withstood the record flood stage.

A similar fate might have awaited Rock Island, which was vulnerable to the record stage. But quick cooperative effort by city, industrial and commercial concerns effected emergency protection. Old levees were raised and strengthened; new levees were built. One interesting aspect of the Rock Island flood effort was the extent to which volunteers, mainly high school and college students, worked around the clock during the period of the flood. Without their effort, Rock Island could not have held out.

The 1965 flood caused more damage to rural areas than in 1951, but again, little actual damage to crops occurred because of the season. Most rural damage was to cabins and cottages extensively built up along the shores.

Final estimates of damages due to the 1965 flood put the total cost (property, lost wages, flood fighting) at $55,366,600. Of this, $37,633,700 was damage to urban areas. 12,956 persons were displaced by the flood in the District, but there were no deaths. Expenditures by the Corps of Engineers in the Rock Island District were $1,965,000.

Although many communities experienced serious economic loss, the Corps' estimate of damages saved due to advance warning was $174,394,600.

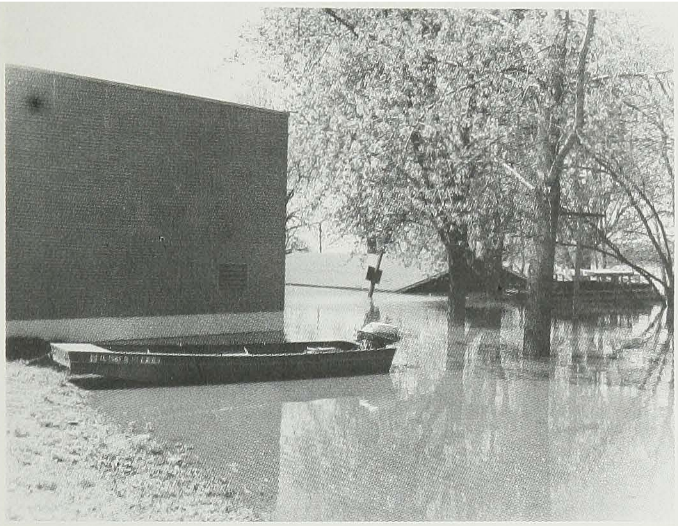


FIG. 69. Quincy, Illinois, during the 1973 flood, another record flood in the District.

FIG. 70 Lock 21 at Quincy during the 1973 flood.

FIG. 71. One of the worst ice jams on the Mississippi occurred in February, 1966. The dark strips on the ice consist of coal dust, dropped on the ice from a plane by the Corps of Engineers in an experiment to hasten melting.

FIG. 72. The newly completed Rock Island levee kept Rock Island dry during the 1973 flood.

FIG. 73. Davenport, Iowa, just across the river from Rock Island, during the 1973 flood, with a flood control project still in the talking stage.

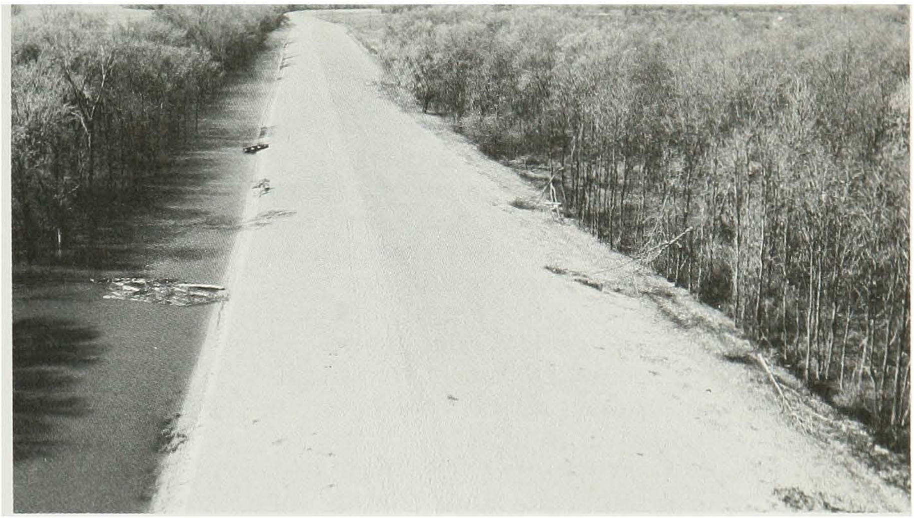


FIG. 74. High water conditions in the Muscatine Island Levee District, showing a typical rural levee system.

By the time of the 1965 flood a number of flood control projects had been completed by the Engineers, and a number of other projects had been authorized and were partially complete. District personnel estimated that one project alone, the Coralville Reservoir, prevented $1,-500,000 in damages. Their estimate of total damages prevented by completed and partially completed projects was $29,812,000. Had all authorized projects been completed in time for the flood, an additional $31,400,000 might have been prevented. That amount included $10,000,-000 for the city of Dubuque alone.

The 1965 flood increased the awareness of many communities of the need for flood control.

*The 1973 Flood.* The 1973 flood was different from the 1965 and 1951 floods in that it was caused primarily by continuous rainfall which brought both tributaries and the main river to high flood levels. Rainfall in the first 6 months of 1973 was 220% of normal. Rainfall recorded in this period at the Moline weather station was 36.72 inches, or almost 4 inches more than the normal amount for a whole year. New monthly records were recorded in March and April.

This rainfall produced record stages on the Rock River in Illinois, and the Wapsipinicon, the Iowa, the Skunk, and the Des Moines Rivers in Iowa, and on several lesser streams.

Prior to the record rainfall of March and April, ice jams and above-normal stream flow caused moderate flood damage to several locations within the District. Throughout the Rock Island District the flood emergency situation extended from January 1 to June 1, except for a brief period in late February.

Because the tributaries were at such high flood levels, each tributary stream added a high contribution to the Mississippi crest as it moved downstream, increasing the flood stage. That meant that at Davenport the 1973 flood ranked as the 5th highest on record, 3½ feet below the 1965 crest, but from Burlington, Iowa, downstream the 1973 flood surpassed all others. By the time it reached Quincy and Hannibal it produced stages 4 feet higher than in 1965.

The 1973 flood was of unusually prolonged duration. The Mississippi was above flood stage at Quincy for 94 days and at Hannibal for 100 days. Because the flood was caused by several periods of rain rather than one large snow melt, it produced 4 major crests during this period.

Damage on the middle and lower Mississippi was especially severe. Preliminary estimates show about $410,000,000 in damage. The total flood damage in the Rock Island District has been tentatively estimated at $60,000,000, but first examinations also show that for the first time in the history of the District, more damage was prevented than occurred. Estimates are that flood protection projects already built in the District prevented an excess of $65,000,000 in damages.

In the period from April 22-26, there were seven major levee failures within the District, inundating about 65,000 acres of farmland. Only one of these, in the Fabius River Drainage

District in Missouri, was a Corps-built project. The total area inundated is estimated to have been 180,000 acres. More than 10,000 persons were displaced by the flood.

*Other Flooding.* One other major cause of flooding has been a frequent problem in the Rock Island District: ice jams. Ice jams occur on the Upper Mississippi and its tributaries (especially the Rock River) each year. Although the majority of these jams happen in reaches away from populations and relieve themselves naturally, a few cause extensive damage.

During the winter of 1965-66 a serious jam occurred just downstream from Dam 15 throughout much of Pool 16. Warm weather in February and an uneven rock ledge bottom in this pool contributed to the backup of ice. Ice from the Rock River knitted into the mass, compounding the problem, and raising the tailwater at Davenport and Rock Island above flood stage.

Engineers applied powdered charcoal, coal dust, and calcium chloride to the ice in an effort to weaken it, but the jam extended for 10 miles in the river, and only marginal results were produced. The Corps chartered two towboats to open the channel. Finally, helped by rotting ice and rising temperatures, the boats broke through the jam on March 1, 1966.

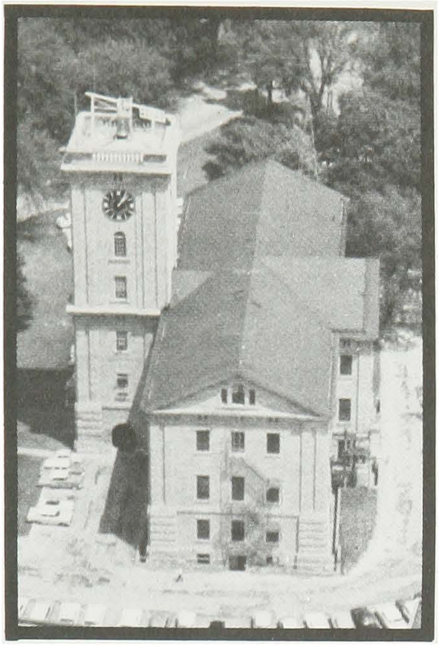
Floods to several communities in the District amounted to $900,000, including physical damage and flood fighting costs. Davenport was the most seriously affected, with damage to about 150 homes.

One benefit of the 1966 ice jam was the initiation of a Corps-wide program of data collection on causes and methods of relieving ice jams.

FOOTNOTES

Chapter XI

1. Anonymous poem, quoted in Fugina, *Lore and Lure of the Upper Mississippi River*, p. 308.
2. The 1917 Act gave more responsibility to the Corps on the Mississippi and Sacramento (Cal.) Rivers, but the 1936 Flood Control Act was the first to authorize specific projects.
3. *Report of the Federal Civil Works Program as Administered by the Corps of Engineers, U.S. Army*, pp. 263-64.
4. Arthur Frank, *The Development of the Federal Program of Flood Control on the Mississippi River* (New York: Columbia University Press, 1930), p. 134.
5. *Annual Report*, 1885, III, p. 1710.
6. *Annual Report*, 1913, p. 1881.
7. R. Monroe, *Notes of Interest, Rock Island District, Wisconsin River to Clarksville* (Rock Island: U.S. Engineer Office, 1935), p. 14.
8. 45 stat. 560. See J. P. Kemper, *Floods in the Valley of the Mississippi a National Calamity* (New Orleans: National Flood Commission, 1928), p. 170.
9. 49 stat. 1570. See Hubert Marshall, "The Evaluation of River Basin Development," *Law and Contemporary Problems*, XXII (Spring 1957), 241.
10. *Annual Report*, 1940, I, pp. 1193-94.
11. Flood Control Act of 1944. 58 stat. 887.
12. Edward Ackerman and George O. G. Lof, *Technology in American Water Development* (Baltimore: Johns Hopkins Press, 1959), p. 496.
13. Rock Island District News Release, August 21, 1969.
14. *Annual Report*, 1970, II, p. 831.
15. Interview with Ray Stearns, Chief of Planning Branch, September 19, 1973.
16. Information taken from *Rock Island District Flood of April-May*, 1951 (Rock Island: Rock Island District, Corps of Engineers, December 1, 1951); *Rock Island District Flood of April-May, 1965, Mississippi River* (Rock Island: U.S. Army Engineer District, Rock Island, June 1, 1966); and from preliminary notes compiled by the Planning Branch for a report on the 1973 flood.



CHAPTER XII

# THE ROCK ISLAND DISTRICT TODAY

In 1966 the Rock Island District celebrated its centennial—100 years of improvement work on the Upper Mississippi. It was a big event: speeches and special programs, a visit by the Chief of Engineers, Lt. General W.F. Cassidy, a series of pamphlets and news releases designed to acquaint the public with Corps activities. 1966 found a District proud of the work it had done and confident of the future.

But the road through the 1950's to this point had not been smooth. Following the exciting years of lock and dam building and the hectic rush of wartime military construction, a letdown was inevitable. This letdown was increased by the Korean War when appropriations fell to a fraction of their former level. On two occasions during the 1950's, Rock Island came close to losing its Engineer Office.

On July 1, 1953, Colonel Nelson Leclair, Jr. arrived in Rock Island to become District Engineer. He had been transferred from the Office of the Chief of Engineers in Washington to supervise the possible closing of the Rock Island District.[1] An information leak occurred during the first part of July and rumors began to circulate that the District might be phased out.

There was some justification for review of the Rock Island District. Expenditures for new work in the District had fallen to lower levels than ever before since 1930. District expenditures fell below $1,000,000 in fiscal 1953, and to $250,000 during 1954. For these two years the only major item of construction was the new 1,200-foot lock at Keokuk. Work on this was maintained only because failure of the old lock built by the Keokuk and Hamilton Water Power Company in 1913 would have interrupted navigation.

Several other Districts in the United States also had greatly reduced work loads. Review of the Rock Island District was part of a general study by the Office of the Chief of Engineers seeking to conserve expenses. There were indications that at least some of the duties in the Rock Island District might be transferred to the St. Louis District.

Had it not been for wide and immediate public support from residents of the Mississippi Valley, the Rock Island District very likely would have been dissolved. But Congressman Thomas Martin of the First Congressional District in Iowa and Congressman Robert B.

Chipperfield of the Nineteenth Congressional District of Illinois began meetings with chambers of commerce in the area and investigations in Washington. As a result of their efforts and those of such important rivermen as Chester Thompson, former mayor of Rock Island and president of the American Waterways Operators, Inc., a final decision to dissolve the District was never made.[2]

In the fall of 1957 rumors again developed that the Rock Island District was to be merged with the St. Paul District, with headquarters at St. Paul. Quick and intensive action by local and national representatives again served to postpone what would almost certainly have been the closing of the District. After a brief increase of activity in the mid-1950's, Rock Island had dropped to the lowest workload of any Engineer District.

This time Senators Bourke Hickenlooper and Thomas Martin, and Congressman Fred Schwengel, all of Iowa, succeeded in getting a final decision postponed until after Congress convened in January.[3] Schwengel arranged a meeting in Rock Island with Chief of Engineers, Maj. General Emerson Itschner on December 9. At this meeting General Itschner revealed that plans had been made to close the Rock Island Office, leaving a small work force of 35 people, but that due to the work of groups interested in keeping the office in Rock Island, the decision had been passed on to the Secretary of the Army and his assistant.

The future of the District did not sound promising. General Itschner felt that the most economical districts were those expending funds of between 15 and 20 million a year. Projections for the Rock Island District were 5.5 million for 1958, 3.8 million in 1959, and reaching only 10.8 million by 1963.

Between the meeting with General Itschner and the scheduled January hearings, Congressman Schwengel and others worked hard to assemble facts supporting the District. A Schwengel-led delegation met in Washington on January 28 with the Secretary of the Army. The result was that on February 5, 1958, Assistant Secretary of the Army Dewey Short announced that the present indefiniteness of flood control work in the Rock Island District made any move premature.

While the Rock Island District survived, it lost its dredge *Rock Island* which was transferred to the St. Lawrence Seaway project. It was never used on that project, except that its presence helped keep contractors' bids low. Before it was transferred, it was used in the District an average of 100 days per year. In its place the *Thompson* of the St. Paul District was assigned to cover dredging duties for both Districts.

Following the low ebb of 1957, District work rapidly picked up. While Red Rock and Saylorville Reservoirs and the Sny Basin project remained the major projects, a number of small boat harbors were planned and constructed by the Corps at Warsaw, Quincy, Moline, and other locations. Urban levee systems were planned for several locations and constructed at Des Moines and Dubuque.

By 1965 the District was engaged in 35 separate navigation and flood control projects. In pursuit of these projects the District expended $23,432,092 in 1965. In 1966, the District's centennial year, Congress appropriated $26,-200,000 for projects in the District, or exactly $25,900,000 more than had been appropriated for Colonel Wilson's projects when he arrived in Keokuk in 1866.

Flood control is today the major activity of the Rock Island District. But it continues to perform a number of other services as well. Operation of the 12 locks and dams within its boundaries requires a field force of 150. Maintenance requires many more. Dredging of the channel and the building and repair of wing dams is an ongoing activity. Constant surveillance of the channel and bank by survey teams must be kept up to guard against the constant washing and bar-forming action of the current. Each of the lock gates is hauled out by the derrickboat *Hercules* about every 15 years for examination and repair.

The Rock Island District also performs several non-navigation and non-flood control services. These include locating fall-out shelters for the Civil Defense, and establishing and improving a growing chain of recreational facilities along the Mississippi and at the reservoirs.

Since 1941 the Corps has engaged in forest management on islands in the river and on Corps-controlled shore areas. Selective cutting of timber by contractors had benefitted the stands of trees and also been profitable to the taxpayer.

The Rock Island District since the mid-1950's has been responsible for procuring survey discs and specially formulated paints for the entire Corps.[4]

The paint lab had its origins in the early 1930's when engineers on the 9-foot channel project discovered that the conventional paints

being used on the lock gates were lasting only an average of three years. The District Engineer asked the lab engineers to investigate better coating systems.

Under two men, John L. Rohwedder as chief of the paint lab and Fletcher W. Shanks as his assistant, the paint lab achieved dramatic results in a very short time. What began as a District project soon received Divisional and then Corps-wide attention. Beginning in 1937 the Office of the Chief of Engineers supported the Paint Lab with funds through the Civil Works Investigation Program. A directive from OCE on May 22, 1953 improved the status of the Lab and broadened its responsibilities, officially establishing it as the central paint lab for the Corps.

The responsibility of the Paint Lab has been to "provide information to all districts and divisions on materials, methods, and equipment which will give satisfactory protection at the least cost to civil works structures."[5] In an attempt to minimize the time span between paint research and development and government use, the Paint Lab evaluated potential coating systems, tested experimental coatings, and formulated paints for use throughout the Corps of Engineers. The Paint Lab also draws up specifications for paints to be submitted to contractors. Until 1973, the Paint Lab conducted yearly training sessions at Rock Island for employees of other districts.

In 1972 the major duties of the Rock Island District Paint Lab were transferred to the Construction and Engineering Research Laboratory, the new Corps facility at Champaign, Illinois. By the end of 1973, all District responsibilities for paint research was phased out.

*The Future of the Rock Island District.*[6] The Corps of Engineers will never reach that magical day when all navigation improvements have been made and all flood protection works erected. No one ever completely tames a river. The Mississippi especially seems to have new tricks up her sleeve each year.

A continued increase in river traffic may well force Congress and the Engineers to make some decision about improvement of the locks by the mid-1980's. Provisions have already been made at each of the locks for an auxiliary lock. These auxiliary locks are already a standard 110 feet wide, and could be built to the length of the new Keokuk lock, 1,200 feet. The advantage of this plan is that it could be done without interferring in any way with navigation through the present locks.

Two other possibilities have been under investigation for some time: artificially lengthening the shipping season by some form of ice-breaking, and deepening the channel to 12 feet to permit barges of greater draft. Preliminary reports on these alternatives are not encouraging. A 12-foot channel, especially, would alter the ecological balance and the shape of the river. It would also require extensive modification to the locks and dams.

Flood control will still remain the major item of business in the Rock Island District for the foreseeable future. As the levee systems increase along the river, they contain flood waters in an ever narrower area. The floods, unable to spread out over their normal flood plain, crest ever higher and higher, increasing the need for additional flood protection.

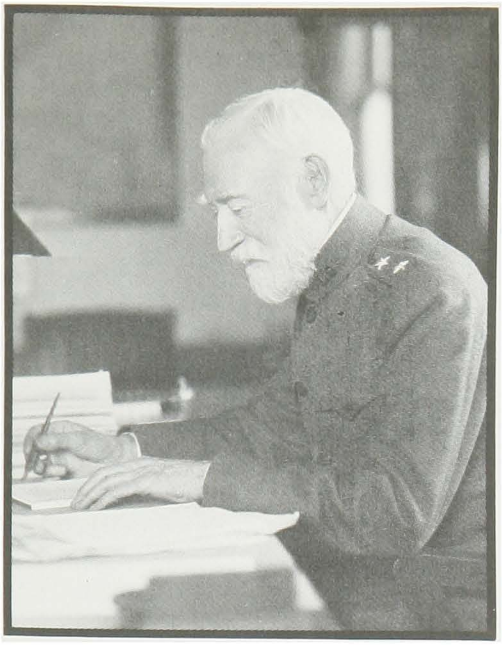
There are no new or dramatic flood control projects in the offing. Several reservoirs have been considered, in addition to those already built, but a rapidly increasing spread of population into once-isolated areas make it unlikely that there will be any future reservoirs. Flood control will likely proceed as in the past, by local projects.

As our awareness of our natural resources and our obligation to them grows, a new direction of involvement for the District may open up: pollution control and water quality management. Several other Engineer Districts in heavily industrial areas have already begun programs to enhance water quality. This new kind of "improvement" of the Mississippi River could well become the Rock Island District's most important future duty.

FOOTNOTES

Chapter XII

1. Interview with Colonel Nelson Leclair, Jr. (Ret.), May 14, 1973.
2. Widely reported in the Rock Island *Argus* and the Davenport *Times Democrat*, various issues, August 11, 1953, to February 9, 1954.
3. Various issues of the *Argus*, *Times Democrat*, and Moline *Dispatch*, September 25, 1957, to February 12, 1958.
4. Interviews with Paul Danker, former Chief of Supply (June 24, 1973) and Willard Lappin, Head, Paint Lab (December 5, 1973).
5. John L. Rohwedder, informal typed and handwritten history of the Rock Island District Paint Lab, Rock Island District Files.
6. Various interviews with Robert Clevenstine, Frank Ashton, Ray Stearns, Colonel Nelson Leclair, Jr.



AFTERWORD

# THE MEN WHO MADE IT HAPPEN

It may seem strange to end this history by *not* adding up the total number of appropriations since 1866, counting the number of linear feet of dams and levees constructed, or measuring the cubic yards of earth, rock, concrete and brush used (or dredged). Such figures would be impressive, considering the long and active history of the District.

But it is more fitting to measure the men than the machines. From the beginning of the improvement work, personnel has been by far the strongest asset of the Rock Island District. The visions and the technical competence of these civil and military engineers have done more to shape the River than all of the yearly politics and appropriations.

At first glance, management of the District seems to violate sound business principles. A normal tour of duty for a District Engineer is only three years. The officer who comes as a new District Engineer usually has been at a quite different kind of duty, and naturally arrives unaware of many of the peculiar problems in a given District. Then almost as soon as he gets on top of things, he is transferred.

From the military standpoint, the purpose of this frequent transfer is to give the officer experience at as many kinds of installations and problems as possible. Civil works provide peacetime training for wartime necessity.

But there is another advantage. Because the Corps' civil works usually involve contract work, because the procedure for authorization of projects often involve politics or special interest groups, and because nearly all improvement projects hurt some interests while helping others, it is essential to have someone in charge who has not had time to make either very close friends or bitter enemies among the population of a District. Contractors and others engaged in river work have come to respect this frequent change of command because they know they will be treated fairly.

Then, too, each of the District Engineers has added his own strengths and interests to the improvement work. These different perspectives have brought understanding and a sound base to the Corps' work on the Upper Mississippi. Many of the District Engineers have been outstanding; two went on to become Chiefs of Engineers: Colonel Alexander Mackenzie and Major Raymond A. Wheeler.

At the same time, under such a system, some form of continuity is essential. There must be

employees on whom the District Engineer can rely for information about the District, employees with experience in the problems of the District. In this, the Rock Island District has been fortunate. It has been the rule rather than the exception for key employees to remain with the Corps for most of their careers. The number of employees who have put in 30 or 40 (and even more) years with the District would be the envy of any private industry. These men and women, with their gradually accumulated knowledge, have provided the steady development of improvement work which has characterized the Rock Island District. Such "river rats" have given the District a continuity and direction it could not otherwise have had.

A long list of civilian engineers who have made outstanding contributions during their careers might be made. L.L. Wheeler, James H. Grove, John Peil, and many other retired employees deserve mention. So do the men now reaching retirement, most of whom came in the early 1930's to work on the 9-foot channel, and who formed a team that provided leadership in that project, in military construction during the War, and in the gradual shift to flood control works in the years since 1950.

Two civilian engineers, however, deserve special mention because they gave so much shape and direction to the early work during its formative period. The most legendary of these men was Montgomery Meigs, who served the District for 52 years, from 1874 to 1926.

Meigs was the son of Lieutenant Montgomery Meigs, who assisted Lee on the Rapids in 1837, and who went on to become Quartermaster General of the Union Army. The younger Meigs was born in [redacted], [redacted] He received engineering degrees from Harvard University and the Royal Politechnical School of Stuttgart, Germany.

When Meigs joined the Rock Island District in 1874 his first task was a comprehensive survey of the worst part of the Mississippi from St. Paul to La Crosse. From this survey Meigs and C.W. Durham developed a plan for wing dams which was eventually incorporated as the 4½-foot project.

In 1876 Colonel Macomb requested that Meigs be appointed a United States Civil Engineer. This post had been established by Congressional resolution in 1867 in order to supplement the number of military engineers engaged in Western rivers improvement work. Of the five such appointments authorized by Congress, three were in the Rock Island District. The first was D.C. Jenne, in charge of the Des Moines Rapids in 1867; the second, H.C. Long, in charge of snag and dredge boats in 1871; and finally, Meigs, in 1876.

Beginning in 1872 when charge of the Des Moines Canal was returned to the Rock Island District, Meigs supervised its operation, and was also in charge of the Mississippi from Burlington to Hannibal. In this capacity he supervised wing dam construction, dredging, and harbor and levee improvements.

His first love, however, was boats. He supervised construction of the dry docks at Keokuk, where he built 14 steamboats and dredges over the years. In addition, he designed four other steamboats built by contractors. The coming of the gasoline launch was Meigs' nemisis. He was an inveterate tinkerer, always trying something new, always looking for new economies. His gas launches contained quantities of improvised parts and the cheapest engines available, and they never did work well or long.

Meigs had a number of other interests, including photography and model building. He was responsible for many of the pictures of early Corps' projects, and he built many models of the improvemnts. He made models of boats, rafts, wing dams, before-and-after improvement river dioramas, and his own inventions for the 1893 World's Fair, for the 1903 Louisiana Purchase Exposition, and for the museum of the West Point Academy.

In 1898 Meigs proposed a method of improving country roads by oiling them, an idea that was adopted throughout the country.

Montgomery Meigs retired from the Corps of Engineers in 1926 at the age of 79. He died on December 9, 1931, at Keokuk.

Although not so widely known today, one of Meigs' contemporaries, C.W. Durham, was also instrumental in shaping the improvement work of the District during the last quarter of the 19th century. Durham arrived to become an assistant engineer in the Rock Island District in 1871, three years before Meigs. In 1873 Durham supervised construction of the first experimental wing dam near Pig's Eye Island. He subsequently worked closely with Meigs in developing the wing dam plan.

Durham held a variety of duties with the Corps during his 49 years with the District. He became Principal Assistant Engineer at the Rock Island Office. From here, for many years, he supervised the snagboat service and was in charge of all bridge matters in the District. He spent several seasons from 1876 to 1881 as

captain of the *Montana* and the *General Barnard*.

As part of his work in the office, Durham wrote a good portion of each of the *Annual Reports*. In the course of this, he wrote many detailed accounts of the history of rapids improvement, the Rock Island fleet, and complete specifications of every wing dam built in the District.

In addition, Durham actually made many of the engineering decisions in the Engineer Office until about 1912. A succession of District Engineers, coming in green, relied on Durham's knowledge and expertise in river matters during their orientation. Durham wrote much of the official District correspondence. On at least two occasions when the District was between officers, Durham handled all duties normally handled by the District Engineer. In 1917, in fact, during the tenure of Major Wildurr Wilding, Durham handled everything; there is no sign in official records that Major Wilding ever arrived in Rock Island.

C.W. Durham, fortunately, was a collector of facts, figures, and records. Now and then this went too far. On September 14, 1912, Major Keller, unable to find his copy of the last River and Harbor bill, wrote a note to Durham: "I have repeatedly asked you not to confiscate, secrete, or remove from the files any of our records."[1] However, this collecting instinct was responsible for the preservation of those records the Rock Island District still has. The *Annual Reports* from 1867 to 1900 in the District files are all Durham's private copies from his office.

Durham suffered increasingly long periods of illness from 1915 on, though he continued to work when he could. He retired in 1920.

Because of men like these, the Rock Island District has won unusual acceptance from people in the Upper Mississippi Valley. Differences of opinion that have flared into angry nationally-publicized fights in several other Districts have not affected the working relationship between the Corps and the public at Rock Island. Critics there have always been, and will be wherever changes affect different groups differently, but most people of the Valley, especially those who have been touched by floods or who use the River, would agree with the river historian E.W. Gould. Writing in response to a critic of the Corps in 1880 who complained about the "fancy military men" who went out to dinner while the laborers did all the work, Gould replies that the accusation may well be true of Engineers in other parts of the country, but certainly not, he said, of "our Engineers."[2]

FOOTNOTES

Afterword

1. Major Charles Keller to C.W. Durham, September 14, 1912, File 1652, Vol. 39, Press Copies of Letters Sent ("General Letter Books"), RG 77, NA.
2. Gould, p. 303.

# APPENDIX A

## ROCK ISLAND DISTRICT ENGINEERS

These brief biographies of Engineer officers who have served as District Engineers with the Rock Island District show in some small way the wide variety of interests and abilities these men have brought to the District. Their dedication, their knowledge, their visions, and their personalities have all played a part in shaping the work of the Corps of Engineers on the Upper Mississippi River.

MAJOR GENERAL JAMES H. WILSON

James Harrison Wilson was born [redacted] Following graduation from the United States Military Academy in 1860, he was commissioned brevet second lieutenant in the Topographical Engineers and stationed in the Department of Oregon. He was promoted to second lieutenant in the fall of 1861, and following a brief tour in the Recruiting Service of the Topographical Engineer Company, became Chief Topographical Engineer of the Port Royal Expeditionary Corps late in 1861. During the summer of 1862, after appointment as brevet major, he served as Chief Engineer of the Department of the South.

In the fall of 1862 he was promoted to lieutenant colonel in the U.S. Volunteers and served in the Maryland Campaign as Acting Aide de Camp to Major General McClellan commanding the Army of the Potomac. He was involved in the Siege of Vicksburg and the Battle of Missionary Ridge, and in 1863 was awarded the rank of brevet lieutenant colonel for meritorious service at the Battle of Chattanooga. He was an expert at bridge construction, gaining most attention for a trestle bridge over the Little Tennessee River built in 32 hours from dismantled houses.

General Wilson was promoted to Brevet Major General, U.S. Volunteers, in 1864 for gallant and meritorious service. On May 10, 1865, a detachment of his forces captured Jefferson Davis, the Confederate President.

On July 28, 1866, General Wilson was appointed a lieutenant colonel in the 35th Infantry, and three days later was assigned to be superintending engineer of the Survey of the Rock and Illinois Rivers. On August 3, he was further ordered to superintend the improvement of the Des Moines and Rock Island Rapids in the Mississippi River. He remained at this post until his retirement from the Corps of Engineers on December 31, 1870.

General Wilson's appointment to the Rock Island District marked the beginning of continuous activity by the Corps of Engineers on the Upper Mississippi River. Under his leadership the first substantial surveys of the

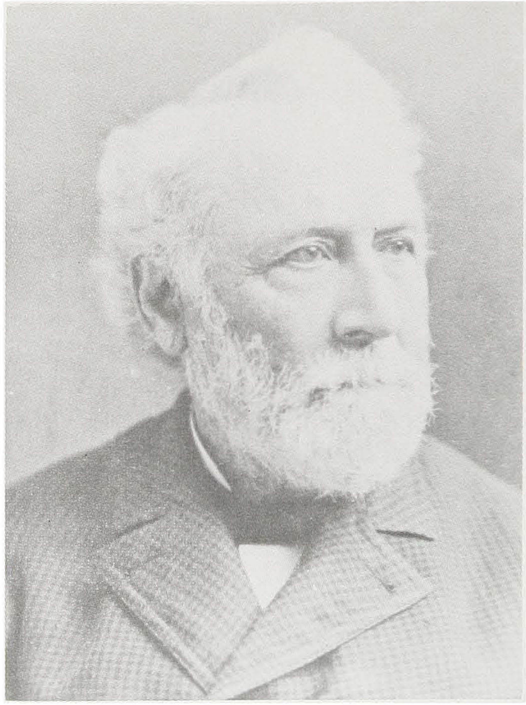
rapids and the Rock and Illinois Rivers were undertaken, and the first permanent improvements of the Des Moines and Rock Island Rapids were planned and begun. His most notable achievement was the design of the Des Moines Rapids Canal around the Des Moines Rapids.

General Wilson maintained a life-long interest in writing, publishing several volumes of biography and memoirs. His first book, *The Life of Ulysses S. Grant*, written together with Charles H. Dana, was written and published while he was District Engineer at Rock Island, in 1868.

Following his resignation from the Army in 1870, General Wilson became Vice President of the St. Louis and Southeastern Railroad from 1870 to 1876. In 1876 he became chief engineer for the Gilbert Elevated Railroad in New York City.

During the Spanish American War General Wilson volunteered for service with the China Relief Expedition. In the fall of 1900 he commanded American troops in the city of Peking, and in 1902 he represented the United States Army at the coronation of King Edward VII.

Between 1900 and 1908 he found time to author several biographies of prominent Americans. He was promoted to brigadier general in 1901 and to major general on the retired list in 1915. General Wilson died in Delaware at the age of 87 on February 23, 1925.



COLONEL JOHN N. MACOMB

John Navarre Macomb was born [redacted] He was commissioned brevet second lieutenant in the 4th Infantry on graduation from the United States Military Academy in 1832. During that year he served in the Black Hawk Expedition. In 1838 he was promoted to 1st Lieutenant, Corps of Topographical Engineers.

Prior to the Civil War Colonel Macomb was on topographical duty at Fort Trumbell (1832-34), was involved in the Survey of Detroit River (1840-42), and served as Assistant Engineer for the Survey of Northwestern Lakes (1842-51). In 1851-56 he was in charge of that Survey, following which he was appointed Chief Topographical Engineer in the Department of New Mexico. In 1860-61 he served as Lighthouse Engineer of the 5th District.

When the Civil War began Colonel Macomb became Chief Topographical Engineer on the staff of Major General McClellan. In 1863 he was made superintending engineer of the construction of fortifications at Portsmouth Harbor, New Hampshire.

After the War Colonel Macomb was appointed Superintending Engineer of the Improvement of the Western Rivers. He was promoted to Colonel, Corps of Engineers, in 1867, and on May 31, 1870, was given charge of several improvement projects on the Upper Mississippi River, including construction of the Rock Island

Bridge and surveys of the Fox, Wisconsin and Minnesota Rivers. On October 1, 1870, he was placed in charge of improvement of the Rock Island and Des Moines Rapids, relieving Colonel Wilson of these duties.

As District Engineer at Rock Island, Colonel Macomb broadened the scope of the improvement work. In addition to continuing Colonel Wilson's projects on the two rapids, he initiated surveys of other treacherous sections of the Mississippi, and experimented with dredging and wing dam construction.

Colonel Macomb remained as District Engineer until November 15, 1877, when he was put in charge of Defense and Harbor Improvements in Delaware Bay. He remained at this post until his retirement on June 30, 1882. He died in Washington, D.C., on March 16, 1889, at the age of 78.

MAJOR FRANCIS U. FARQUHAR

Francis Ulric Farquhar was born [redacted] He graduated second in his class from the United States Military Academy in 1861 and was commissioned second lieutenant in the Corps of Engineers. He served with the Corps in various positions during the Civil War: drilling volunteers, as Aide-de-Camp to Colonel Heintzelman in the Manassas Campaign in 1861, and at the Battle of Bull Run. In 1863 Major Farquhar served as Chief Engineer of the Department of Virginia and North Carolina, and from 1864 to 1865 was Assistant Professor of Engineering at West Point.

Prior to his appointment as Rock Island District Engineer, Major Farquhar worked on harbor improvements in Lake Erie (1866-67), as Assistant Engineer for the Survey of the Northern Lakes (1867-68), and as Superintending Engineer of Harbor Improvements on the eastern shore of Lake Michigan (1868-72). Following his promotion to major in the Corps of Engineers in 1872, he served as Chief Astronomer of the Survey of the 49th Parallel of Latitude to fix the Northern Boundary of the United States (1872-73).

He became Superintending Engineer of Surveys and Harbor Improvements in the Upper Mississippi Valley and the West End of Lake Superior in 1873. In this capacity he had charge of projects in what is now the St. Paul District.

In November 1877 Major Farquhar was assigned to relieve Colonel Macomb of projects in his charge in the Rock Island District. He served in this capacity until June 30, 1879. During these years Major Farquhar laid the groundwork for the 4½-foot channel project, surveying, mapping, and experimenting with improved boats and machinery.

Major Farquhar died in Detroit on July 3, 1887, at the age of 45.

BRIGADIER GENERAL ALEXANDER MACKENZIE

Alexander Mackenzie was born [redacted] He graduated from the United States Military Academy in 1864 and was commissioned second lieutenant in the Corps of Engineers. His tours of duty included Assistant Engineer, Department of Arkansas (1864-65), examination of levees of the Lower Mississippi (1865-66), and, following promotion to Captain in 1867, Improvement of Harbors of Lake Michigan (to 1879).

On June 30, 1879, General Mackenzie replaced Major Farquhar as District Engineer at Rock Island. He served in this capacity for 16 years, longer than any other Rock Island District Engineer. During his tenure in office he supervised completion of the Des Moines and Rock Island Rapids projects, saw the 4½-foot channel well under way, and developed standardized plans and methods of improving the Mississippi River. He was promoted to lieutenant colonel in February 1895 near the end of his tour at Rock Island.

General Mackenzie was among the best liked District Engineers. His colleagues found him "kind, patient, congenial."

In 1895 General Mackenzie became a member of the Lighthouse Board, and in 1902 a member of the Board of Engineers for Rivers and Harbors. He was promoted to Colonel in 1901, and in 1904 he was promoted to Brigadier General and Chief of Engineers, a post he served until his retirement in 1908.

General Mackenzie came out of retirement in 1917 in response to a World War I shortage of military personnel. He returned to the Rock Island District as District Engineer and Division Engineer of the Northwest Division until June 1, 1919.

General Mackenzie died in Washington, D.C., on February 23, 1921, at the age of 76.

LIEUTENANT COLONEL WILLIAM R. KING

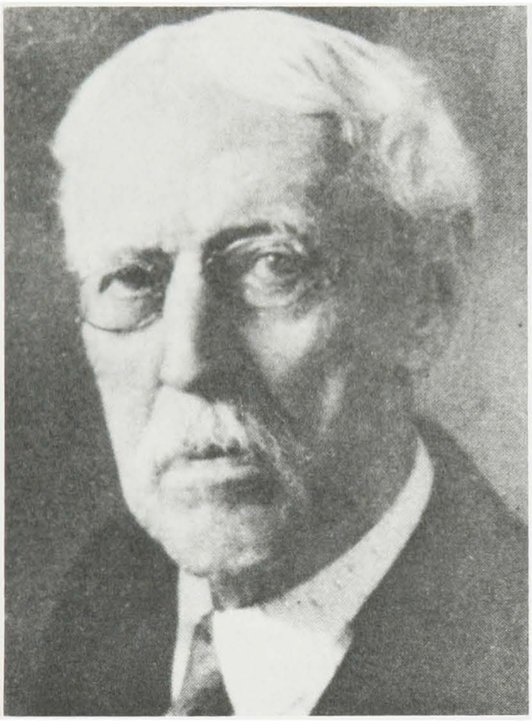
William Rice King was born in [redacted]. He graduated from the United States Military Academy in 1863, was commissioned a second lieutenant in the Corps of Engineers, and assigned as Assistant Engineer in the Department of North Carolina and Virginia from 1863-65.

He was promoted to captain in 1865 and assigned as Assistant Engineer with the Bureau of Washington, D.C. Between 1886 and 1895 he was in charge of construction at Fort Schuyler, New York. He was promoted to lieutenant colonel in 1888.

Colonel King served as District Engineer at Rock Island from July 6, 1895, until May, 1898. During these three years his health was precarious. Much of the office work and correspondence was taken over by civilian

assistants. Colonel King died at Rock Island on May 18, 1898.

In addition to his varied military duties, Colonel King engaged in a number of civil projects. He was the projector and constructor of an inclined cable road to the summit of Lookout Mountain, Tennessee, in 1885-86, and served as president of the company operating the road in 1886-87. He authored several technical works, including *Experimental Firing with Modern Seacoast Artillery* (1868), *Armor Plating for Land Defenses* (1870), and *Counterpoise Gun Carriage* (1869).



COLONEL CURTIS McD. TOWNSEND

Curtis McDonald Townsend was born in [redacted] He graduated from the College of the City of New York in 1875 with a B.A. at the age of 19. On the advice of a friend he entered a competitive examination and received an appointment to the United States Military Academy. He was graduated in 1879, 4th in his class, and commissioned a second lieutenant in the Corps of Engineers.

His first assignment was to Willets Point, New York, where he served until 1882, when he was promoted to first lieutenant. He served as Assistant Engineer at Baltimore, Maryland, and Petersburg, Virginia. In 1886 Colonel Townsend became Assistant to the Engineer Commissioner in the District of Columbia. He returned to Willets Point in 1887 as Quartermaster of the Engineer Batallion in charge of building construction. In 1890 he was promoted to Captain and assigned to duty in Washington, D.C., in connection with the construction of the Washington Aqueduct.

In 1896 Colonel Townsend was placed in charge of the Third Mississippi River District at Memphis, Tennessee. He was transferred to Grand Rapids, Michigan, in May, 1898, and, upon the death of Colonel King, was transferred to Rock Island as District Engineer.

Colonel Townsend served at Rock Island from 1898 until March 31, 1903. During this time the 4½-foot channel project was virtually completed. He published many articles dealing with engineering problems on the Upper Mississippi and encouraged his civilian engineers to do likewise. Much of the preservation of these early records in print today is due to the encouragement of Colonel Townsend.

In 1903 Colonel Townsend was assigned to the 3d Engineer Battalion in the Philippine Islands, where he served on the staff of the Chief Engineer, Philippine Division. During this time he was promoted to major. He supervised constuction of military roads, building the Manila Breakwater, and wharves for the City.

Colonel Townsend returned to Washington, D.C., in 1906 as a member of the Board of Engineers for Rivers and Harbors. He then served tours of duty at Cleveland, Ohio, and Detroit, Michigan. In 1912, having been promoted to Colonel, he became Division Engineer of the Western Division at St. Louis, also serving as president of the Mississippi River Commission and as a member of the Experimental Towboat Board.

During World War I Colonel Townsend served in France. He retired in 1920, but was recalled from 1924-26 as District Engineer of the New Orleans District. Following World War I, Colonel Townsend wrote a basic college textbook, *Hydraulic Principles Governing River and Harbor Construction*, and published many articles in engineering journals.

Colonel Townsend died in Ithaca, New York, on May 26, 1941, at the age of 85.

COLONEL JAMES L. LUSK

James Loring Lusk was born in [redacted] Following graduation from the United States Military Academy in 1878 and a commission as second lieutenant in the Corps of Engineers, he served as Assistant Instructor of Practical Military Engineering and of Natural and Experimental Philosophy at West Point. He remained at the Academy in the Departments of Tactics and Mathematics until 1881. In 1881 he was promoted to first lieutenant and served as an assistant to Major Danrell at the Academy until 1883.

In 1886 Colonel Lusk became Secretary and Assistant of the Construction Committee of the Mississippi River Commission. He was promoted to Captain in 1888 and became Assistant to the Engineer Commissioner of the District of Columbia. In 1893 he returned to the Military Academy as Instructor of Practical Military Engineering, a position he held until the Spanish-American War. He was promoted to major in 1898 and given command of Company E, Battalion of Engineers, 5th Army Corps. In May of 1898 he was promoted to lieutenant colonel and Chief Engineer, U.S. Volunteers.

In the fall of 1898 Colonel Lusk was made Assistant to the Chief of Engineers in Washington, D.C. On March 31, 1903 he replaced Colonel Townsend as District Engineer at Rock Island. During his tour as District Engineer, he supervised preparations for the coming 6-foot channel project, including preliminary plans for the Moline Lock on the Rock Island Rapids, and the Keokuk and Hamilton Power Company dam at the foot of the Des Moines Rapids. On April 26, 1906, Colonel Lusk was transferred to the Survey of North and Northwestern Lakes.

He died at Sandy Hook, New Jersey, on September 26, 1906, at the age of 51.

COLONEL CHARLES S. RICHE

Charles Swift Riche was born in [redacted]. He was graduated third in his class from the United States Military Academy in 1886. Following a commission as second lieutenant in the Corps of Engineers, he was ordered to Willets Point, New York, where he served with the U.S. Battalion of Engineers, and attended the Engineer School of Application (from which he graduated in 1889).

From 1889 to 1895 Colonel Riche was on duty at Detroit, Michigan, and Sault Ste. Marie, Michigan, as Assistant Engineer on the Survey of the North and Northwestern Lakes. He assisted in the design and construction of the Poe Lock, Sault Ste. Marie. Between 1895 and 1903 he saw duty at Willets Point; at the 4th District of Lower Mississippi River Improvement; as Assistant to the District Engineer at

Galveston, Texas, then District Engineer at Galveston, where he supervised construction of the Galveston Jetties and built many of the fortifications of Galveston Harbor; and as Chief Engineer Officer, Department of Texas. He was promoted to captain in 1898.

In 1903 Colonel Riche was placed in charge of the Second Chicago District covering the improvement of th Illinois River and the Illinois and Mississippi Canal. In 1904 he was promoted to major.

He became District Engineer at Rock Island on April 1, 1905, while still retaining charge of the Second Chicago District until 1906 when the operation of the Illinois and Mississippi Canal was transferred to the Rock Island District and the Second Chicago District was dissolved. In addition to supervising construction of the Illinois and Mississippi Canal, Colonel Riche supervised planning and construction of the Moline Lock and initiated work on the 6-foot channel project after preliminary surveys were authorized in 1905.

On March 15, 1910, Colonel Riche was transferred to Detroit, Michigan, in charge of the Coast Survey of the Lakes and of the Harbors of the East Shore of Lake Michigan. He remained at this post until 1912, when he resumed his post at Galveston, Texas, in charge of the Galveston Engineering District. He remained at Galveston until 1916 when he returned to Chicago, following promotion to Colonel.

From 1918 to 1921 Colonel Riche was in Panama as Chief Engineer Officer constructing fortifications.

Colonel Riche retired in 1921 after 38 years of service. Following his retirement he was engaged in consulting engineering work in various parts of the country, based at St. Louis. His most notable civil work was as a member of the Chicago Sanitary District Engineering Board of Review.

On March 20, 1926, Colonel Riche died in Houston, Texas, at the age of 61.

COLONEL CHARLES KELLER

Charles Keller was born [redacted] He graduated second in his class from the United States Military Academy in 1890 and was commissioned a second lieutenant in 1892.

He was promoted to first lieutenant in 1895, to captain in 1900, and to Major in 1907. Prior to coming to Rock Island, Colonel Keller's tours of duty included Improvement of Lake Michigan at Grand Rapids (1901-03), the Philippines (1903-05), and charge of the Survey of Northern and Northwestern Lakes from 1905 to 1910.

Colonel Keller served as Rock Island District Engineer from March 15, 1910, until October 16, 1913. While this was a frustrating period for river interests, with a rapid decline of long haul freight and passenger service on the Upper Mississippi, it was a period marked by rapid growth for the District as it prepared to spend $2,000,000 a year on the 6-foot channel project. The Keokuk and Hamilton Water Power Company began construction of their power dam just after Colonel Keller arrived and completed it just two months before he left. While District Engineer at Rock Island, Colonel Keller was also a member of the Experimental Towboat Board.

Following his tour of duty at Rock Island, he served on the War Industries Board in 1917-18,

and at the Office of the Engineer Commissioner at Washington, D.C., in 1921-23.

He retired in 1923 and joined the Byelesby Engineering and Management Corporation in Chicago, where he was responsible for construction of the El Dorado power project near Placerville, California.

He died in California on September 16, 1949, at the age of 85.

BRIGADIER GENERAL GEORGE M. HOFFMAN

George Matthias Hoffman was born in [redacted] He graduated second in his class from the United States Military Academy, received a commission as second lieutenant, and was assigned to River and Harbor duty at New Orleans.

The outbreak of the Spanish-American War interrupted his course at the Engineer School at Willets Point, New York. In Cuba he served in the field with the Engineer Battalion during the Santiago Campaign, then returned to the Engineer School for a second tour. He was promoted to first lieutenant in 1898. For the next three years he was on engineering duty in Washington, D.C., working on the Aqueduct water supply tunnel and on filtration plants. He then served as Assistant Instructor at the General Service and Staff College, Fort Leavenworth, Kansas, and on River and Harbor work at Galveston, Texas, and Vicksburg, Mississippi.

In 1904 he was promoted to Captain and appointed as Assistant Division Engineer, Isthmanian Canal Commission, and Resident Engineer, Panama Canal Zone. The difficult and crucial task of constructing the Gatun Dam was under his charge.

After nearly six years in the Canal Zone, General Hoffman was ordered to duty as District Engineer at Rock Island, replacing Major Keller on October 16, 1913. He served in this capacity until April 30, 1917. Most of the work in the District during his tenure consisted of continued development of the 6-foot project, of which the largest single project was the Le Claire Canal at the head of the Rock Island Rapids. During this time the Rock Island District fleet, already large, grew to be by far the largest of any District in the United States, numbering almost 200 named boats.

World War I brought most civil works in the District to a halt. On April 30, 1917, General Hoffman was transferred to Fort Benjamin Harrison, Indiana, as Senior Engineer Instructor at the Officers Training Camp. In July he was ordered to France as Assistant Chief of the American Expeditionary Force, but within a few weeks he was placed in command of the Eleventh Engineers, an important railway regiment attached to the British Army on the Somme. In January, 1918, he was appointed Chief Engineer of the First Corps, with which he saw action in the offensives of Chateau-Thierry, St. Mihiel, and Meuse-Argonne. For his ability in these campaigns, he was awarded the Distinguished Service Medal. In 1919 he was promoted to Colonel.

Following the War he became District Engineer at Louisville for one year. He graduated from the Army War College in 1921 and was placed on the General Staff Corps Eligible List. The following year he was sent to New Orleans to become Division Engineer of the Gulf Division and a member of the Mississippi River Commission.

He then briefly returned to troop duty in 1926, then took over duties as District Engineer of the First New York District, and, in 1931, became Division Engineer of the North Atlantic Division.

He retired from active duty in 1934 with the rank of brigadier general, and died on November 1, 1936, in Montclair, New Jersey, at the age of 66. He was buried in Arlington National Cemetery.

LIEUTENANT COLONEL WILDURR WILLING

Wildurr Willing was born [redacted] He graduated from the United States Military Academy in 1901 and was commissioned second lieutenant in the Artillery. In 1902 he transferred to the Corps of Engineers.

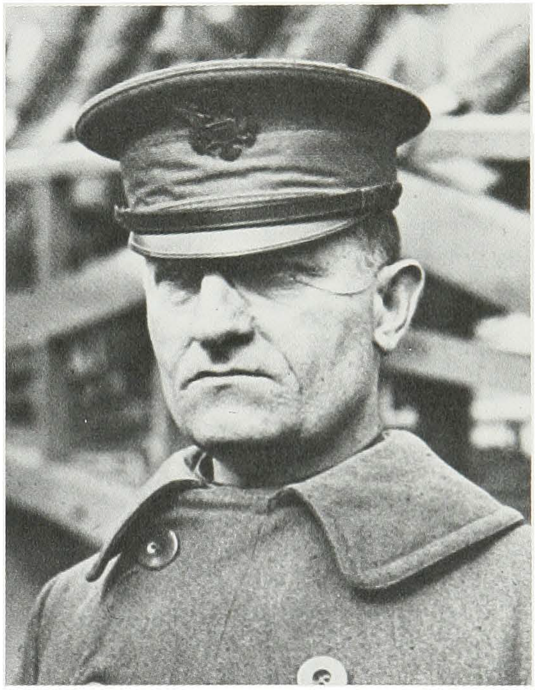
From 1902 to 1905 Colonel Willing was Instructor of Engineering at the United States Infantry and Cavalry School. He was promoted to first lieutenant in 1904, and in 1905 was assigned to the Insular Government, Panama, as Assistant Lighthouse Engineer. He was promoted to Lighthouse Engineer in 1907. In 1908 he returned to the States to River and Harbor work at New Orleans.

Colonel Willing was appointed District Engineer at Rock Island on April 30, 1917, to replace Major Hoffman, who had been transferred because of the war effort. He served in this capacity less than two weeks, until May 12, 1917, when General Alexander Mackenzie came out of retirement to return to the District.

Not only was Colonel Willing's tenure as District Engineer the shortest in the history of the District, there is no evidence in the Rock Island District Files or elsewhere that he ever actually arrived in Rock Island. All correspondence was carried on by civilian employees. His appointment as District Engineer became one of the casualties of hurried wartime planning.

Colonel Willing was promoted to colonel in 1917, returned to the grade of Major following the War, and promoted to lieutenant colonel in 1920.

Following the War, Colonel Willing served as District Engineer at Boston, Massachusetts; as Department Engineer, Panama Canal Zone; as Division Engineer, Panama Canal Division (1927-28), and as District Engineer at St. Paul (1929).



BRIGADIER GENERAL HARRY BURGESS

Harry Burgess was born [redacted], [redacted] He attended the Agricultural and Mechanical College of Mississippi for three years before entering the United States Military Academy in 1891. He graduated second in his class in 1895, and was commissioned a second lieutenant, Corps of Engineers.

Following graduation General Burgess served tours of duty as Assistant to the District Engineer at Savannah, Georgia; and as an assistant in the development of Mobile, Alabama, Harbor. After attending the Engineer School of Application at Willets Point, he was engaged in submarine mine defense of the harbors of Galveston and New Orleans.

In 1900 General Burgess was assigned as Instructor of Engineering at the United States Military Academy, but after serving only a few months, he left to serve with the Engineer

Battalion in the operations of the Philippine Insurrection.

From 1903 to the beginning of World War I he served as District Engineer in charge of works at Louisville, Kentucky; New Orleans, Louisiana; Nashville, Tennessee; and Detroit, Michigan. In 1917 he organized the 16th Engineer Railway Regiment at Detroit, commanded it and took it to France. In France he was Corps Engineer and Commander of the 305th Engineers.

During this time he received regular promotions: to first lieutenant in 1898, to captain in 1904, to major in 1909, to lieutenant colonel in 1917 and to colonel in 1920.

General Burgess arrived in Rock Island as District Engineer on June 1, 1919. The War had interrupted most projects in the District, and it became General Burgess' responsibility to get them moving again. Actual construction of the Le Claire Lock was begun, and work resumed on dredging, wing dams, and other projects on the 6-foot channel. He left the District on June 16, 1922, to become Commandant of the United States Engineer School at Fort Humphreys, Virginia.

In 1924 he became Engineer of Maintenance of the Panama Canal, and in 1928, Governor of the Panama Canal Zone. Upon his retirement in 1932 when his tour of duty as Governor was over, he was made a Brigadier General of the Line of the Army. He died at the Army Hospital in Hot Springs, Arkansas, on March 19, 1933.

BRIGADIER GENERAL BEVERLY C. DUNN

Beverly Charles Dunn was born [redacted] He graduated from the United States Military Academy in 1910 and was commissioned second lieutenant, Corps of Engineers.

Prior to coming to Rock Island General Dunn served as an instructor at the Army Industrial College and was engaged in River and Harbor work in New York. He was promoted to captain in 1919 and major in 1920.

General Dunn became District Engineer at Rock Island on June 16, 1922. During his five years in this office, the work of the District grew increasingly complex. The long decline in river traffic reversed with the virtual completion of the 6-foot channel, and the District broadened its responsibilities to include flood protection work on levees south of Rock Island. The Le Claire Canal and Lock was completed and opened to traffic. General Dunn remained as District Engineer until August 15, 1927.

During World War II General Dunn served as Deputy and then Chief Engineer with the Supreme Headquarters Allied Expeditionary Forces under General Eisenhower in Europe. He retired with the rank of brigadier general in 1948, after 30 years of service with the Army.

Following retirement he served with the Association of American Railways and became

chairman of the board of James King and Co., a large firm of general contractors in New York City. General Dunn died on August 21, 1970, in New York.

COLONEL CHARLES L. HALL

Charles Lacey Hall was born in [redacted] He graduated from the United States Military Academy in 1908, a classmate of another Rock Island District Engineer, Major Glen Edgerton.

He was commissioned a second lieutenant and served in Hawaii on survey work in 1908. In 1916-18 he served with the Punitive Expedition into Mexico. He was promoted to Colonel, General Staff, 1st Army AEF in 1917-18, and to major in 1919. In 1920 and again in 1926-27, Colonel Hall served in the Office of the Chief of Engineers. From 1924-26 he was a member of the War Department General Staff.

Colonel Hall became District Engineer at Rock Island on August 16, 1927, and remained until December 12, 1930. This period saw increased flood protection work assigned to the District following the disastrous flood of 1927. These were also the years in which the growing pressure from river interests finally brought about passage of a 9-foot channel in the River and Harbor Bill of July 3, 1930.

Following his tour as Rock Island District Engineer, he became Assistant Professor of Civil and Military Engineering at the United States Military Academy. In 1941 he became District Engineer of the Ohio District and served until 1945, retiring with the rank of colonel.

Colonel Hall died on March 24, 1963.

MAJOR GENERAL GLEN E. EDGERTON

Glen Edgar Edgerton was born [redacted] He graduated at the head of his class from the United States Military Academy in 1908, was commissioned a second lieutenant, and sent to serve with the Isthmanian Canal Commission.

From 1916 to 1918 General Edgerton served with the Punitive Expedition into Mexico, was War Department Director of Sales in 1921-23, and Assistant Chief Engineer, and then Chief Engineer, FPC, from 1924 to 1929. In 1929 he was appointed Assistant Professor of Civil and Military Engineering at West Point.

General Edgerton arrived in Rock Island as District Engineer on December 13, 1930, where he supervised the transformation of the District into a complex modern organization, planning construction of the locks and dams for the 9-foot channel. Construction of the first lock and dam, No. 15, was begun during his tenure as District Engineer. He served at Rock Island until August 31, 1933.

From 1940 to 1944 General Edgerton served as

Governor of the Panama Canal Zone. Following this he became Deputy Director, and then Director, of material for the War Assets Administration (1945-46); Director of the United Nations Recovery and Reconstruction Agency in China (1946-47); and a member of the War Department Board (1947). He also served as President of the Beach Erosion Board of the Corps of Engineers before retiring in 1949.

Following retirement, General Edgerton became Executive Director of the Committee on Renovation of the White House during the Truman Administration. He was president of the Export-Import Bank from 1953 to 1955, and has served as a consulting engineer for the World Bank and director of several corporations.

General Edgerton lives in Washington, D.C.

LIEUTENANT GENERAL RAYMOND A. WHEELER

Raymond Albert Wheeler was born [redacted] He graduated from the United States Military Academy in 1911, fifth in his class.

Prior to coming to Rock Island, General Wheeler participated in the Vera Cruz Expedition; served as commander of the 4th Regiment of Engineers in Germany in World War I; became District Engineer of the Newport, R.I., District in 1919; and served as Assistant to the Engineer of Maintenance of the Panama Canal Zone from 1927 to 1930. From 1930 to 1933, General Wheeler was District Engineer at Wilmington, North Carolina.

General Wheeler became District Engineer at Rock Island on September 22, 1933, and remained until October 3, 1935. Under his direction, most of the locks and dams in the District were begun. In 1934 he supervised the transfer of the District offices from downtown Rock Island to the more expansive quarters in the Clock Tower Building on Arsenal Island. During his tenure as District Engineer he directed the expending of more funds than had been spent by the Rock Island District in its entire previous history.

In 1935 General Wheeler was made Chief Regional Engineer for the Works Progress Administration. In 1940 he was assigned to the Panama Canal as Engineer of Maintenance, where he remained until 1941, when he was assigned to the Persian Gulf Command. In 1942 he became commanding general of Army Services of Supply Forces on the China-Burma-India Theater. He became Deputy Commander of Supreme Allied Forces in Southeast Asia, and principal administrative officer of the Southeast Asia Command. In this capacity he directed lend-lease to all allied forces in that area. In 1945 General Wheeler became Commanding General, United States Forces in the China-Burma-India Theater, and in September, 1945, he was the United States representative at the Japanese surrender ceremonies in Singapore.

General Wheeler was appointed Chief of Engineers in October 1945 and served in this position until 1949. Following the Egypt-Israel War in 1956 he was appointed Chief United Nations representative in clearing the Suez Canal, a job completed in three months, well under the one-year estimate. In 1960 he supervised dredging the mouth of the Congo to allow ocean shipping to go 80 miles upriver.

Since his retirement with the rank of lieutenant general, he has lived in Washington, D.C., where he has served as engineering advisor to the International Bank for Reconstruction and Development.

COLONEL EARL E. GESLER

Earl Ewart Gesler was born in [redacted] He graduated from the United States Military Academy in 1915. In 1916-17 he participated in the Punieive Expedition into Mexico.

During World War I he held temporary ranks as captain (1919) and major (1920). He received permanekk promotion to captain in 1922 and to major in 1923.

From 1920 to 1924 Colonel Gesler held the rank of Assistant Professor of Military Science at Iowa State University at Ames. In 1928 he served as an instructor with the New York National Guard.

Colonel Gesler first served as Acting District Engineer at Rock Island from October 10, 1935 to August 13, 1936. He was then promoted to Lieutenant Colonel and appointed District Engineer. He served until August 4, 1939. During this tour he directed completion of the locks and dams for the 9-foot channel. The last one, Number 14 at Le Claire, was finished just two months before the end of his tour. He also supervised the start of specifically authorized flood control projects in the District, 14 of which were authorized by the Flood Control Act of 1936.

Colonel Gesler left the Rock Island District in 1939 to take charge of the Contract and Finance Section of the Office of Chief of Engineers. From 1943-46 he was Division Engineer of the Mid-Atlantic Division, and in 1949-50 he was District Engineer at Philadelphia.

Colonel Gesler died in Chicago, Illinois, on August 11, 1958.

MAJOR GENERAL CHARLES P. GROSS

Charles Philip Gross was born [redacted] He graduated third in his class from the United States Military Academy in 1914. He was promoted to captain, Corps of Engineers, in 1917 and served in Europe with the American Expeditionary Force.

Following promotion to major in 1920, he completed a Master of Arts in Engineering at Cornell University in 1921. He served as instructor of Engineering at West Point in 1922-23, and as Instructor in Tactics from 1923-26.

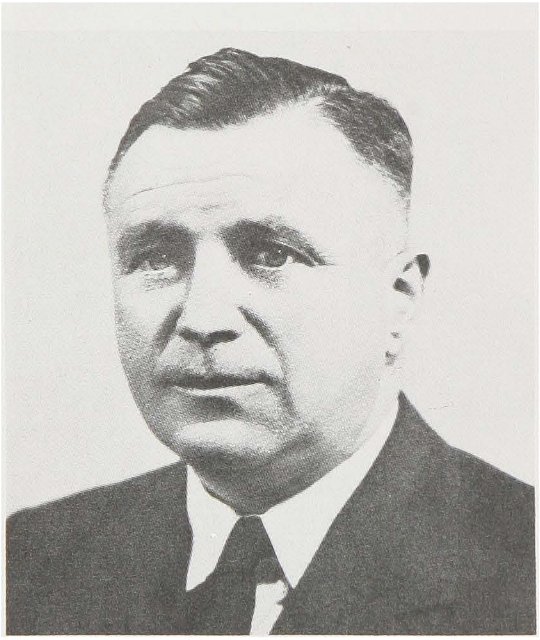
From 1927-29 General Gross was District Engineer at Los Angeles. He served as officer in charge of a barge canal survey in Nicaragua in 1929.

General Gross became District Engineer at Rock Island on November 24, 1939, and served until January 28, 1941. During this period he supervised preliminary planning and survey work for Coralville Reservoir, the first of the flood control reservoirs authorized in the District.

Following his tour of duty at Rock Island, General Gross served as Chief of Transporta-

tion Division of the Harriman-Beaverbrooke mission to London and Moscow in 1941-42. He also handled transportation arrangements for the Quebec, Malta, Yalta, and Potsdam conferences held by Allied leaders during World War II. During the War he also served as Chief of the Army Transportation Corps and ran the national railroads after they were taken over by the Government.

Following retirement from the Army in 1945, with the rank of Major General, General Gross accepted a position as Chairman of the Board of Transportation for the City of New York. He now lives in Cornwall-on-Hudson, New York.



COLONEL CLINTON W. BALL

Colonel Clinton W. Ball served a short term as District Engineer at Rock Island from January 29, 1941 until May 15, 1942. He supervised construction of the one-story building immediately west of the Clock Tower. This building now houses the District garage, automatic data processing (computer) center, comptroller and finance and accounting office, procurement and supply division, and foundations and materials branch, and several conference rooms. Most of the military construction supervised by the Rock Island District during the War was also initiated during this period.

Colonel Ball is now a licensed civil and mining engineer and lives in San Marcos, Texas.

COLONEL WILLIAM J. MATTESON

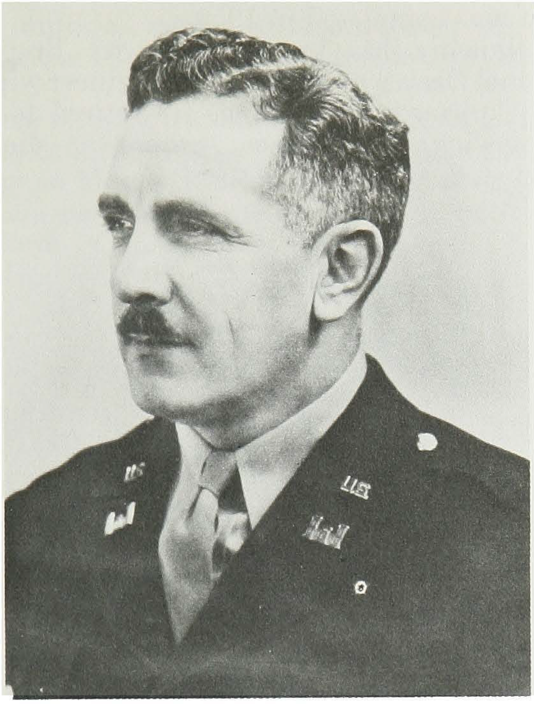
William Joseph Matteson was born [redacted] He graduated from the United States Military Academy in 1928 and was commissioned Second Lieutenant, Corps of Engineers.

His tour of duty as District Engineer was also quite short, from May 16, 1942 to February 15, 1943. During this time he was promoted from lieutenant colonel to colonel. Because of the War almost no civil works were carried on during this period. Extensive military construction continued, however, both on Arsenal Island and in the field.

Following his tour of duty at Rock Island, Colonel Matteson became Executive Officer of the Engineer Board at Fort Belvoir, Virginia. He served here until 1946, when he retired from the Army.

He later served on the Board of Transportation of the City of New York under General Gross, and was associated with the American Institute for Economic Research.

He now lives in Great Barrington, Massachusetts.



LIEUTENANT COLONEL JOHN H. PEIL

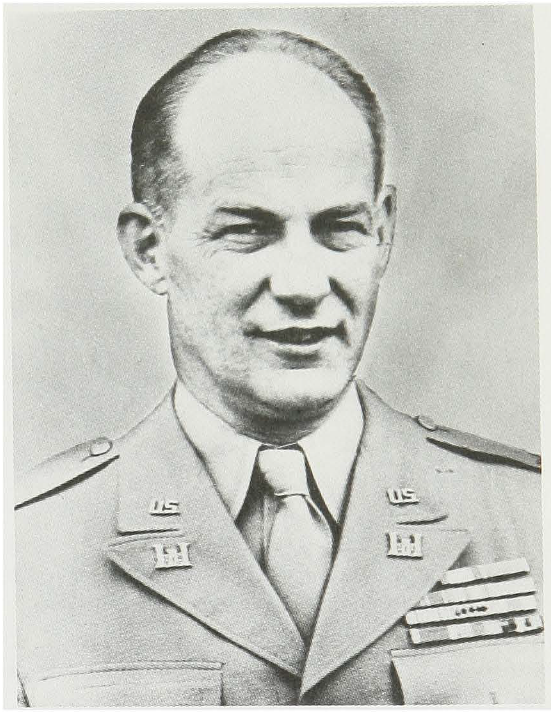
Lieutenant Colonel John H. Peil was the only Rock Island District Engineer to serve the Rock Island District both as an officer and as a civilian. In both capacities he served the District from 1931 until his retirement in 1965.

Prior to coming to the Rock Island District as resident engineer in charge of Locks and Dams Number 15 and 20, Colonel Peil worked for the Louisville, Kentucky, District and on the construction of locks and dams on the Ohio River. He received a degree in civil engineering in 1924.

When Lock 20 was completed in February 1936 Colonel Peil transferred into Rock Island District Headquarters to become head of the District construction section. From August 1940 to 1942 he served as engineer in charge of the planning section of the District's engineering division.

In July, 1942, he was commissioned as major in the Corps of Engineers. He continued his engineering assignments until February 1943 when he was promoted to lieutenant colonel and reassigned as District Engineer of the Rock Island District. Colonel Peil served as District Engineer from February 1943 to April 1946. During and after World War II he supervised the design and construction of more than $80 million in military construction projects, as well as supervising major flood fighting efforts on the Des Moines and Rock River and the Mississippi River in 1944, 1945, and 1946. On February 1, 1946, Colonel Peil was awarded the Legion of Merit for his work and the work of the District during the War.

In 1946 Colonel Peil returned to his civilian engineer status to become Chief of the Engineering Division in the Rock Island District and chief technical assistant to District Engineers. He retired in December 1965, served as Assistant Professor of Mathematics at Culver Stockton College in Canton, Missouri, and now lives in Vincetown, New Jersey.



COLONEL WILLIAM N. LEAF

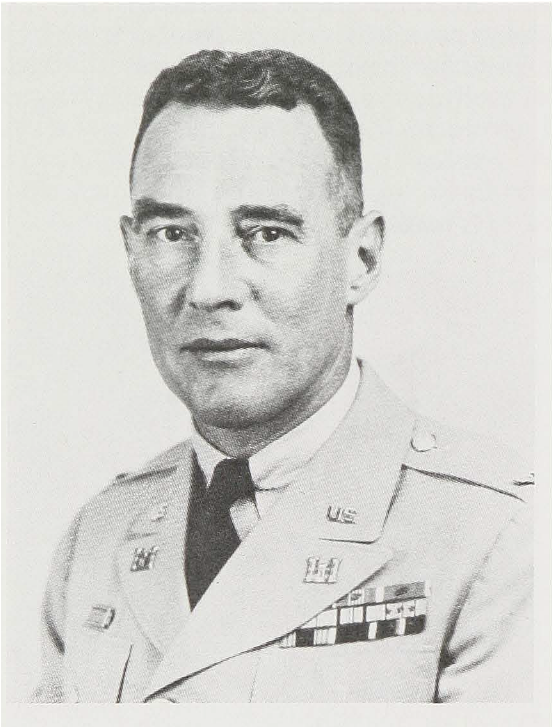
William Newton Leaf was born in [redacted] Following graduation from the United States Military Academy in 1923, he was commissioned second lieutenant in the Corps of Engineers. He attended Cornell University in 1925-26, from which he received a graduate degree in civil engineering.

From 1943-45 Colonel Leaf served with the 592nd Engineer Company, Amphibious Regiment, 6th Army, Southwest Pacific, Philippine Theater.

Colonel Leaf arrived in Rock Island as District Engineer on April 9, 1946. His tenure as District Engineer marked a period of return to civil works which had been interrupted by the War. Most of the District work during his tour of

duty involved emergency and regular (authorized) flood control works.

Colonel Leaf died on June 1, 1948, while serving as Rock Island District Engineer.



COLONEL REGINALD L. DEAN

Reginald Langworthy Dean was born in [redacted] He graduated from the United States Military Academy in 1924 and was commissioned a second lieutenant. As was the case with his predecessor as Rock Island District Engineer, Colonel Dean attended Cornell University and graduated with a degree in civil engineering in 1926. During the 1930's he taught at the United States Military Academy.

During World War II Colonel Dean served with the construction section of the Far East Command in Australia, New Guinea, and the Philippines. In 1945 he served with the Luzon Engineer District, and after the War became assistant engineer of the Eighth Army in Japan.

Colonel Dean began his tenure as District Engineer at Rock Island on June 21, 1948, and remained until September 1, 1950. A series of floods from 1943 through 1948 kept the emergency flood protection work high in the District. In addition, work on the Coralville Reservoir continued. The earth embankment portion of the dam was completed in 1950.

Following his tour as District Engineer, Colonel Dean was assigned as engineer with the 5th Corps at Fort Bragg. He retired to East Brunswick, New Jersey, where he died on August, 8, 1966.

COLONEL GEORGE A. FINLEY

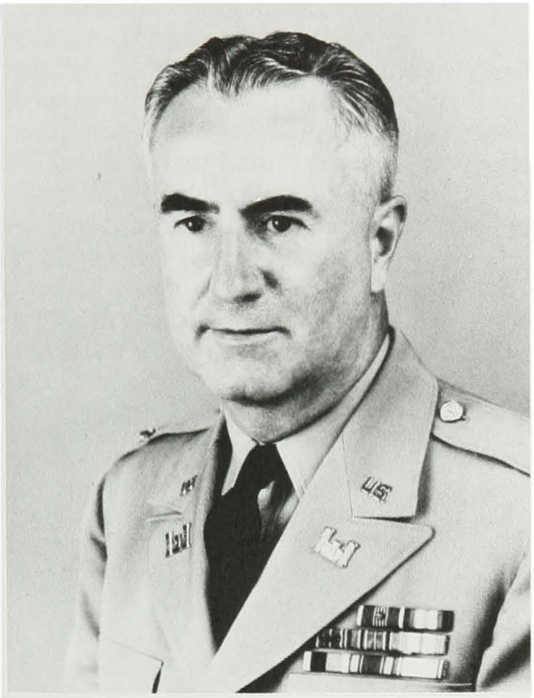
George Alexander Finley was born [redacted] He graduated from the United States Military Academy in 1936 and went on to earn a Master of Science in Engineering from Cornell University in 1939. He served with the U.S. Air Force from 1942-45.

Colonel Finley served as Rock Island District Engineer from September 5, 1950, to June 1, 1953. Although a major flood in the spring of 1951 kept the District active, the Korean War severely curtailed civil works projects during this period. Work continued only on the new 1200-foot lock at Keokuk because of the importance of an open channel to national defense.

Following his tenure as Rock Island District Engineer, Colonel Finley served as District Engineer of the Corps' Okinawa District in the Far East in 1956-57. He then organized the Canaveral District in Florida in 1963 to supervise Air Force and space construction in the Cape Kennedy area. The Canaveral District more than doubled in size and completed nearly

$145 million worth of construction projects during the 16 months it was headed by Colonel Finley.

Since retiring from the Army in 1964, Colonel Finley taught engineering drawing at a junior college in Miami, Florida. In 1966 he accepted a position as Dean of the Engineering School at Guilford College in Greensboro, North Carolina.



COLONEL NELSON LECLAIR, JR.

Colonel Nelson Leclair, Jr. served as District Engineer at Rock Island from July 1, 1953, until February 28, 1955. He is a graduate of Norwich University, Northfield, Vermont.

Prior to World War II, Colonel Leclair worked for several years with the Illinois Division of Highways. During the War he served in the 372nd Engineer Regiment in the European Theater as part of General Patton's Third Army.

After the War he served for two years as Deputy Foreign Liquidation Commissioner for Latin America in South America, and for two years in a similar capacity in Paris. He then served in the Office of the Chief of Engineers until his assignment to Rock Island.

Colonel Leclair's years at Rock Island were marked by continued inactivity of civil projects due to the Korean War. Expenditures for civil projects due to the Korean War. Expenditures for civil projects reached an all-time 20th Century low of $250,000 in 1954. Consequently, the District faced the possibility of having its duties transferred to the St. Paul and St. Louis Districts, a move that was forestalled by the combined efforts of area citizens and congressional representatives.

Following his retirement from the Army in 1955, Colonel Leclair has served as vice president for the Iowa-Illinois Gas and Electric Company of the Rock Island-Davenport area. He now lives in Bettendorf, Iowa.

COLONEL JOHN L. WILSON, JR.

Colonel John L. Wilson, Jr. served as District Engineer at Rock Island from March 1, 1955, to July 31, 1958. In the 1930's Colonel Wilson was an architect and an engineer in private practice in San Antonio, Texas. From 1939 to 1941 he was chief architect for the Southwest Texas Division of the Federal Housing Administration.

In 1941 Colonel Wilson went on active duty with the Army, and supervised the construction of airfields and army camps in the Southwest during the War. In 1946 he left the service and resumed private practice as an architect-engineer in San Antonio, Texas.

He became a major in the Corps of Engineers in 1947 and served as engineer of the Western Area Command of the U.S. Army in Europe in 1953-54.

Colonel Wilson served as District Engineer at Rock Island from March 1, 1955, to July 31, 1958. During these years the Rock Island District went through another crisis of possible merger with the St. Paul District, a crisis again avoided by strong local support from cities, citizens, and river interests. These years also saw completion of the Coralville Reservoir in Iowa, and a gradual increase in appropriations following the lean Korean War years.

Colonel Wilson is now retired and lives at New Braunfels, Texas.

COLONEL EDMUND M. FRY

Colonel Edmund M. Fry was born [redacted] He was commissioned in the Corps of Engineers in 1938 following graduation from the University of Oklahoma with a Bachelor of Science degree in civil engineering.

During World War II Colonel Fry commanded the 12th Engineer Battalion in Europe. He was captured by the enemy in France, but escaped a few days later to rejoin his unit. After returning to this country Colonel Fry attended the Command and General Staff College, Fort Leavenworth, Kansas, and then completed a Master's degree in civil engineering from Iowa State University at Ames.

From 1948 to 1952 he was Staff Engineer, General Headquarters, Far East Command. During 1952 he attended the Armed Forces Staff College, Norfolk, Virginia. From 1952 to 1955 Colonel Fry was at the Engineer School at Fort Belvoir, Virginia, and in command of the 79th Engineer Construction Group. Just prior to his assignment to Rock Island, he was Engineer, Southern Area Command, U.S. Army Europe, Germany, from 1955 to 1958.

Colonel Fry was District Engineer at Rock Island from August 6, 1958, to July 21, 1961. During this period the Saylorville Reservoir was authorized and entered the planning stage, and the first construction work was finally begun on the long-interrupted flood control reservoir at Red Rock, Iowa, on the Des Moines River.

Following his tour of duty at Rock Island, Colonel Fry attended the Army War College before proceeding to an assignment in Korea. In 1964 he was assigned to duty with the North Central Division of the Corps of Engineers where he remained until his retirement from the Army on May 31, 1966. After his retirement, he was employment at Benham Blair, Oklahoma City, Oklahoma, where he now lives.

COLONEL RICHARD L. HENNESSY

Richard L. Hennessy was born [redacted] He graduated from the United States Military Academy in 1943 and served in Europe with the 110th Engineer Combat Group during World War II.

Following the War, Colonel Hennessy completed a Master's degree in civil engineering from Iowa State University at Ames. He was stationed at Fort Belvoir, Virginia, from 1947 to 1950, and then served as project engineer and battalion commander from 1950 to 1952, during the Korean War. From 1953 to 1956 he served as chief of the Military Assignments Branch in the Office of the Chief of Engineers. Following this he served for three years as a resident engineer and Assistant District Engineer for Operations in the Alaska Engineer District. In 1960-61 he was commanding officer of the 160th Engineer Group at Fort Knox, Kentucky.

Colonel Hennessy served as District Engineer at Rock Island from July 24, 1961, until his retirement from the Army on June 30, 1964. The primary responsibilities of the District during this period were flood control projects.

Since retirement, Colonel Hennessy has been teaching engineering at Michigan Institute of Technology at Houghton, Michigan.

COLONEL HOWARD B. COFFMAN, JR.

Howard Beverly Coffman, Jr. was born in [redacted] He graduated from the United States Military Academy in 1943 and was commissioned in the Corps of Engineers.

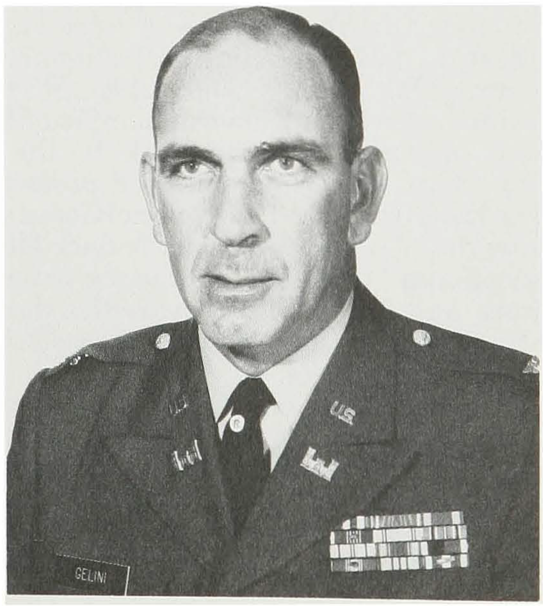
During World War II he served with the 311th Engineer Battalion (Combat), 86th Infantry Division. He participated in the campaign of Central Europe and served in the Philippines.

Following the War, Colonel Coffman completed a Master's degree in civil engineering at the University of Iowa, Iowa City. He attended the Engineer School at Fort Belvoir, Virginia; the Command and General Staff College, Fort Leavenworth, Kansas; and the Armed Forces Staff College, Norfolk, Virginia. In addition to tours of duty in Okinawa, Korea, and Germany, Colonel Coffman also served in the Office of the Chief of Engineers and in the Office of the Deputy Chief of Staff for Military Operations prior to coming to Rock Island.

Colonel Coffman became Rock Island District Engineer on July 1, 1964, and remained until July 10, 1967. During this period the District celebrated its centennial. His tour of duty was marked by the 1965 flood, worst in the District's history, and by a rapidly increasing work load as several major flood protection projects got under way.

Colonel Coffman served a second tour of duty in Germany after leaving Rock Island. He then went to Vietnam, where he was deputy brigade commander of the 18th Engineer Brigade and then deputy commander of the U.S. Army Engineer Brigade and then deputy commander of the U.S. Army Engineer Command, Vietnam.

Colonel Coffman served as Deputy Division Engineer for Civil Works of the Southwestern Division of the Corps of Engineers at Dallas, Texas from 1971 to 1973, when he retired from the Army. He is now with Texas Utilities Services Inc. of Dallas, Texas and lives in Dallas.



COLONEL WALTER C. GELINI

Walter C. Gelini was born in [redacted] He graduated from the United States Military Academy in 1945 and was commissioned in the Corps of Engineers. He first served in Korea as a company commander for three years. He then spent four years with the Armed Forces Special Weapons Project at Sandia Base, New Mexico. In 1954 he received a Master of Science degree in civil engineering from Harvard University.

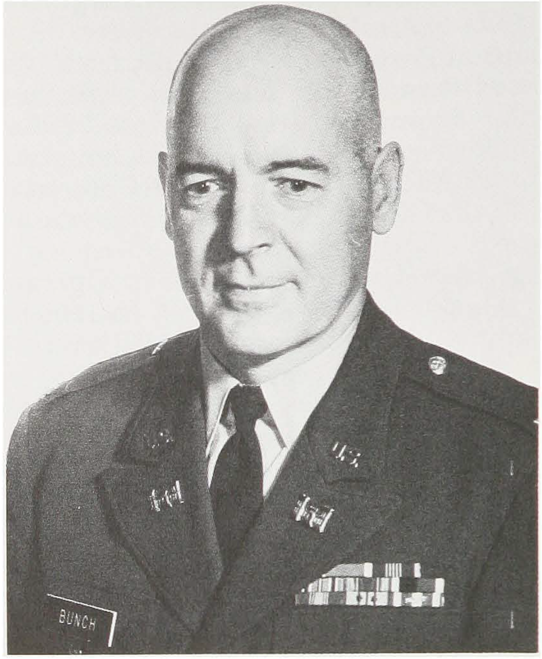
Colonel Gelini served two years in Korea from 1954 to 1956 with the 169th Engineer Group and the Eighth Army. He next served in Washington, D.C., as a staff officer in the Planning Studies Division, Army Map Service, and was graduated from the Command and General Staff College, Fort Leavenworth, Kansas. From 1957 to 1960 he was an instructor at the United States Military Academy.

In 1960 he was assigned to the Mediterranean Division of the Corps of Engineers and served for two years as Assistant and Area Engineer at Immir, Turkey. Following graduation from the Army War College in 1963, he completed a Master of Arts degree in international affairs at George Washington University in Washington, D.C.

Colonel Gelini commanded the 17th Engineer Battalion, 2nd Armoured Division, Fort Hood, Texas, in 1963-64. After a year in Washington, D.C., as an Army staff officer in the Pentagon, he commanded the 921st Engineer Group at Fort Leonard Wood, Missouri, going to Vietnam with that group. Upon its deactivation, he assumed command of the 79th Engineer Group.

He became District Engineer at Rock Island on August 21, 1967, remaining until January 18, 1970. During his tenure as District Engineer at Rock Island, Red Rock Dam was completed and put into operation, another link in the increasing chain of permanent flood protection works in the District. In 1969 Colonel Gelini was presented the Army Meritorious Service Medal for exceptional service in emergency preparation work and flood fighting activities during the spring floods of that year on the Mississippi and Des Moines Rivers.

In January 1970, Colonel Gelini was assigned to become commanding officer of the Mobility Equipment Research and Development Center at Fort Belvoir, Virginia. However, he became ill shortly thereafter and died on May 17, 1970, at Walter Reed Hospital in Washington, D.C.




COLONEL JAMES E. BUNCH

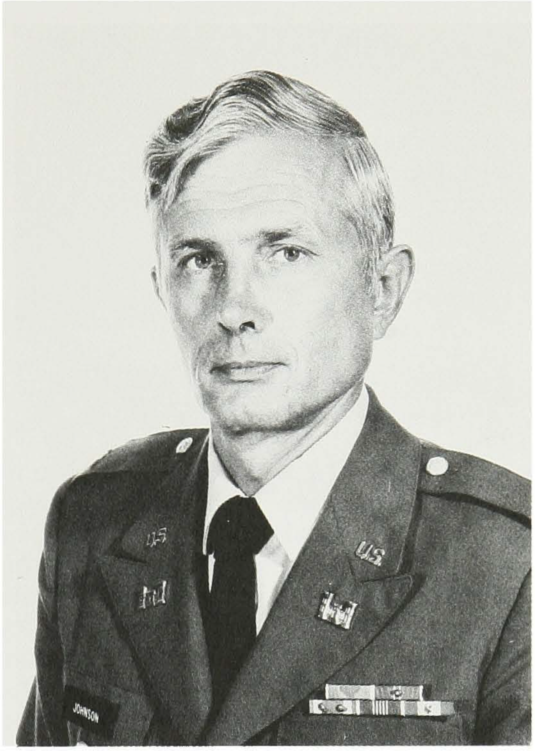
James E. Bunch was born in [redacted]. He was commissioned in the U.S. Army Corps of Engineers in 1949 following his graduation from Oklahoma State University, Stillwater, Oklahoma. In 1955 he completed a Master's degree in civil engineering from Iowa State University, Ames.

His military education included graduation from the Engineers School, Fort Belvoir, Virginia; Command and General Staff College, Fort Leavenworth, Kansas; Armed Forces Staff College, Norfolk, Virginia; and the Army War College, Carlisle Barracks, Pennsylvania.

Prior to coming to the Rock Island District, Colonel Bunch served in Vietnam and had assignments at Fort Belvoir, Virginia; Goose Bay, Laborador; Fort Wainwright, Alaska; Fort Wolters, Texas; and in the Office of the Chief of Engineers, Washington, D.C.

Colonel Bunch became District Engineer at Rock Island on January 19, 1970, and served until July 31, 1972.

Following his tour of duty at Rock Island, Colonel Bunch became Chief of the Office of Personnel Administration in the Office of the Chief of Engineers.



COLONEL WALTER H. JOHNSON

Walter H. Johnson was born on [redacted] He was commissioned in the Corps of Engineers upon graduation from the United States Military Academy in 1951.

His military training included graduation from the Engineer School, Fort Belvoir, Virginia; Command and General Staff College, Fort Leavenworth, Kansas; and the Army War College, Carlisle Barracks, Pennsylvania. He also holds a Master of Science degree in civil engineering from Texas A & M College, and is a registered professional engineer in New York State.

Colonel Johnson has served tours as a branch chief in the Construction Division of the Office of the Deputy Chief of Staff for Logistics, Department of the Army; as a staff officer with II Field Force, Vietnam; as commander, 83d Engineer Battalion (Construction), U.S. Army, Europe; as an assistant professor at the United States Military Academy; as commander, 161st Engineer Company (Missile Command), Korea; and as assistant to the Division Engineer and executive officer, New England Division of the Corps of Engineers.

Immediately prior to coming to Rock Island, he served as assistant to the Deputy for Installations and Housing, Office of the Assistant Secretary of the Army (Installations and Logistics).

Colonel Johnson became the 33rd District Engineer at Rock Island on August 1, 1972. In addition to another major flood in the spring of 1973, his tour has been marked by increasing multi-purpose river development and increasingly complicated ecological concerns.

# APPENDIX B

## CHIEFS, ENGINEERING DIVISION
## ROCK ISLAND DISTRICT

In order to establish continuity in the work of Upper Mississippi River improvement, given the relatively short tours of duty of the District Engineers, the Rock Island District early established a policy of appointing one civilian employee as the District Engineer's principal assistant. Various titles were given to this position: "Principal Assistant Engineer," "Senior Engineer," and, since the formation of an engineering division in 1944-46, "Chief of the Engineering Division."

One indication of how much continuity was provided in this way is that in its 107-year history, the Rock Island District has had only five principal engineers. These were: C.W. Durham, Richard Monroe, H. G. McCormick, Lieutenant Colonel John H. Peil, and Frank Ashton.

Brief biographies of these men follow, with the exception of Colonel Peil, whose biography will be found among the District Engineers.

## C. W. DURHAM

Charles William Durham was born in Maine where his father was a lumber merchant. He graduated from Harvard University in 1868, and from 1869-70 did graduate work in engineering at the University of Heidelberg, Germany, and at the Institute of Technology at Boston. In 1870 he was employed by the C. B. & Q. Railroad in Nebraska.

Mr. Durham came to Rock Island as an assistant engineer for the Rock Island District in 1871. He began work as a civil engineer on the Rock Island Rapids project, but was soon assisting with many of the reports and surveys being undertaken by Colonel Macomb. He participated in the construction of the first experimental wing dams on the Upper Mississippi River in 1873, and the following year assisted Montgomery Meigs in the survey and report that led to the use of wing dams as the principal means of channel improvement.

In 1876 Mr. Durham was appointed Captain of the snagboat *Montana*, retaining this position for several years. Gradually, he assumed more and more responsibility for supervising projects in the District. He was placed in charge of snag and dredge boats, and of all matters relating to bridges in the District. He worked particularly closely with General Alexander Mackenzie, District Engineer from 1879 to 1895. Sometime during this period he came to be known, unofficially, as Principal Assistant Engineer.

Apparently, this title remained an unofficial one until Mr. Durham retired in 1920, after 50 years of service with the District. Letters in the Rock Island District files show that Mr. Durham querried each new District Engineer in turn about retaining that title.

Mr. Durham's contributions were invaluable not only to the Corps of Engineers during his long stay in Rock Island. He also served the community in many ways. For four years, as a Colonel in the Illinois National Guard, he served as Aide-de-Camp to the Governor of Illinois. He served on the Rock Island Public Library Board for six years and on the Board of Education for nine. He was a member of the Masonic Lodge and a member and officer of many local service clubs.

For nearly all of his 50 years in Rock Island, Mr. Durham resided in a large mansion on the southeast corner of 11th Street and 1st Avenue.

Congress passed new pension and retirement laws in 1920. Along with a number of other employees long past retirement age in the District Office, Mr. Durham retired on July 31, 1920, with a pension of $720 per year. Following retirement he moved to La Mesa, California, to be near his daughter.

## RICHARD A. MONROE

Richard A. Monroe was born [redacted], [redacted] Following graduation as a structural engineer, he worked for several Midwestern and Western railroads as lineman, chainman, and topographer. He entered Government service as an employee of the Rock Island District on September 22, 1894.

Except for a brief period of low activity in the District in 1901-02, when he took local charge of double track construction for the Chicago, Burlington, and Quincy Railroad, Mr. Monroe served continuously with the Rock Island District until his retirement on December 31, 1937. He served in a variety of positions: as surveyor and inspector on levee work and other flood control projects, as inspector on the construction of rock and brush dams and shore protections under contract, as assistant in charge of similar work done by hired labor and Government plant, on hydraulic dredging, and on construction of the Moline and Le Claire Locks. He also played an active part on the construction, operation, and maintenance of the large District fleet.

In 1920, following the retirement of C.W. Durham, Mr. Monroe was named Principal Civilian Assistant to the District Engineer. As engineering work on the Upper Mississippi increased in the 1920's and headed toward the 9-foot channel, organization in the District Office became more complex. Consequently, on November 1, 1929, Mr. Monroe was promoted to the newly-created post of Senior Engineer.

During construction of the District's 12 locks and dams for the 9-foot channel, Mr. Monroe served primarily as a consultant in the Operations Division in connection with the many problems with which his wide background made him knowledgeable. Because of this, in 1934 he was named Civilian Assistant to the District Engineer in the Operations Division, in addition to his title of Senior Engineer.

Mr. Monroe was widely respected by those with whom he worked. An old friend and fellow employee said of him, "Monroe doesn't always

deliver the goods by express. Sometimes they come by freight, but you can bet that when the consignment arrives you will always find it complete; all the goods are there, properly labeled and ready for use." (quoted in the Rock Island District publication, *Safe Channel*, December, 1937, p. 35).

Following his retirement he remained in Rock Island, enjoying a wide variety of interests from astronomy to short hand and bridge. He died on August 7, 1945, in Rock Island.

### H. G. McCormick

H. G. McCormick was born [redacted] He was a graduate of Virginia Polytechnic Institute in Blacksburg, Virginia.

Mr. McCormick transferred into the Rock Island District in April, 1930, after more than 20 years with the Corps of Engineers on the Ohio and Lower Mississippi Rivers. He became Head Civilian Engineer in 1937, following Mr. Monroe's retirement, and remained at that post until his own retirement in 1946.

Mr. McCormick is noted for his work on the design and construction of locks and dams of the 9-foot channel, and is remembered especially for the guidance and counsel he gave on that project to young engineers who have since gone on to serve the Corps of Engineers well.

### Frank W. Ashton

Frank W. Ashton was born in [redacted], [redacted] He graduated from the University of Iowa, Iowa City, in 1930 with a Bachelor of Science degree in civil engineering. For two years after graduation he worked as a structural engineer for the American Bridge Company in Gary, Indiana.

He joined the Rock Island District as a structural engineer in 1933. From 1933 until World War II, he worked on the design of gates for the navigation dams as part of the 9-foot channel project.

In July 1942 Mr. Ashton was commissioned as a captain in the Army and assigned as chief of construction work to convert the old Bettendorf Company plant in Bettendorf into the Quad-City Tank Arsenal. When this project was completed in 1943, Major Ashton returned to the District Office as chief of military construction for the Rock Island Arsenal and military head of the engineering division. He was discharged with the rank of lieutenant colonel in 1946.

From 1946 until he became chief of the engineering division in 1966, Mr. Ashton served as assistant chief of that division. He retired in June 29, 1973.

During his 40 years with the District, he supervised much of the design work for three large flood control reservoirs in Iowa: Coralville Lake, near Iowa City; Lake Red Rock between Knoxville and Pella, Iowa; and the Saylorville Lake project northwest of Des Moines. In addition, he was concerned with many flood protection projects in the District.

In 1966 Mr. Ashton was appointed Flood Executive Officer. He coordinated the District's flood efforts during the 1967 flood, and again in 1969 and 1971.

He received two meritorious civilian service awards, the second highest civilian award presented by the Corps of Engineers. The first was for his work as Flood Executive Officer during the Operation Foresight flood emergency program in 1969, and the second, presented in June 1973, was in recognition of his understanding and resourcefulness as an engineer.

He was a registered professional engineer in Iowa, a fellow of the American Society of Civil Engineers, and a member of the Society of American Military Engineers.

Frank Ashton died on November 21, 1973.

### Doyle W. McCully

Doyle W. McCully, the present chief of the Engineering Division and chief engineer consultant of the Rock Island District, was born in [redacted] He graduated from the University of Mississippi in 1958 with a civil engineering degree and began his career with the Corps of Engineers as a junior engineer trainee assigned to the Huntington, West Virginia, District.

In 1959 he transferred to the Design Branch of the Huntington District office, where he worked until 1967. During this time he had various design responsibilities, including local flood protection projects, channel rectifications, erosion control and protection and navigation projects on the Ohio River.

In 1967 Mr. McCully transferred to the Office of the Chief of Engineers in Washington, D.C., where he was assigned to the Planning Division of Civil Works, managing design memoranda for civil works projects and conducting studies for water resources planning and policy matters. In August 1970 he was promoted to chief of the Cost Allocation Section. From December 1971 to June 1972 he supervised authorization planning activities, including material to be used by officers appearing before Congressional Public Works Committees.

Mr. McCully received a Master's degree in civil engineering in the field of water resources engineering from Catholic University in Washington, D.C., in 1971. Immediately prior to his assignment to the Rock Island District, he was senior regional planning engineer in the Urban Studies Branch of the Office of the Chief of Engineers, with overall management responsibility for several urban studies programs throughout the United States.

Mr. McCully began his new duties as Chief of the Engineering Division with the Rock Island District on October 15, 1973, replacing Frank Ashton, who had retired in June.

He is a registered professional engineer in the State of Mississippi, a member of the American Society of Civil Engineers, and a past president of the Huntington, West Virginia, post of the Society of American Military Engineers.

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*Unpublished Sources*

By far the largest number of records in this category came from the collection, Textual Records of the Office of the Chief of Engineers, Record Group 77, in the National Archives. Documents used from this collection include the many volumes of *Letters Received by the Chief of Engineers* between 1826 and 1886, and entries 1651 through 1684, inclusive, from the "Preliminary Inventory" by Maizie H. Johnson, all of which relate to the Rock Island District.

The remainder of unpublished sources come from the Historical Files of the Rock Island District Office and the Historical File of the Keokuk Public Library, Keokuk, Iowa.

Taped interviews with several present and retired employees of the Rock Island District proved to be a significant source of information.

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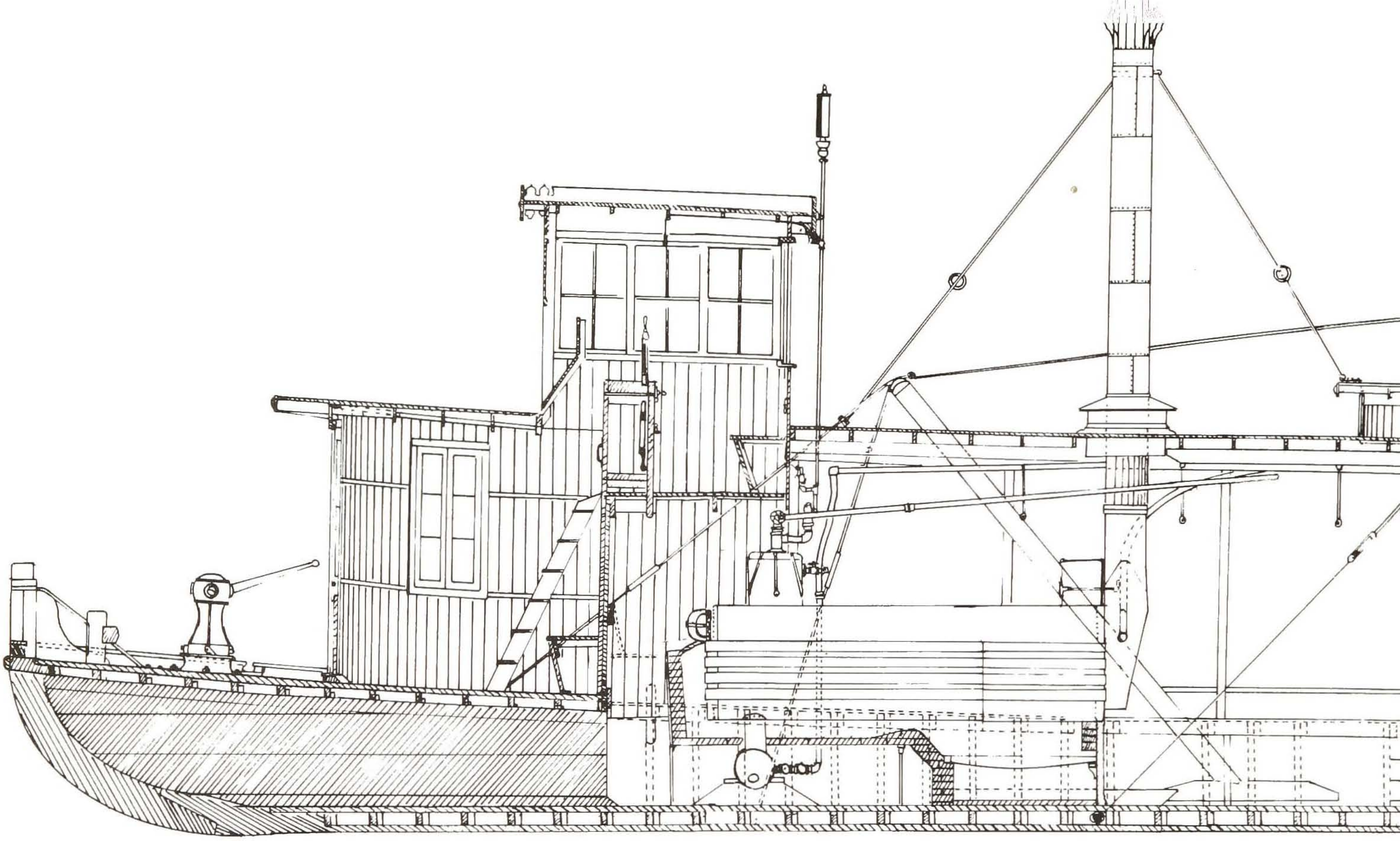


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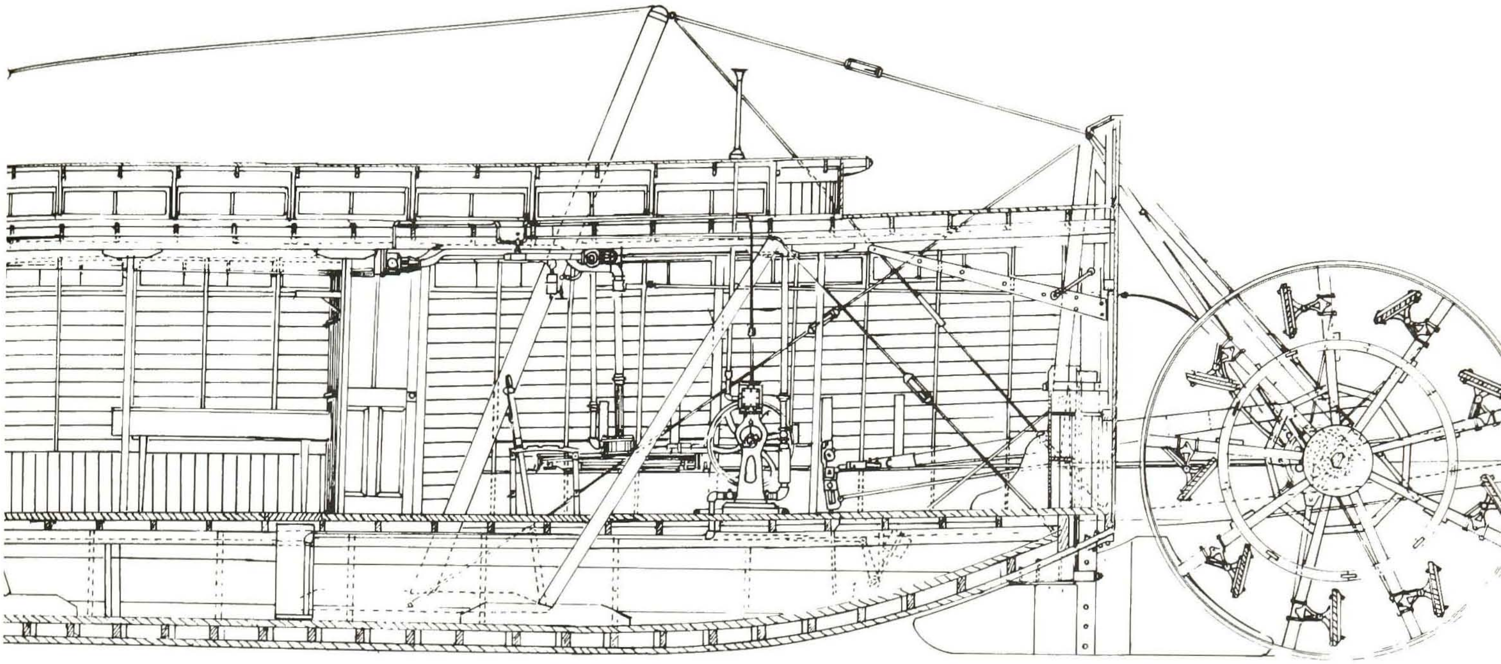

FIG. 75. Side view of the steam launch *Lucia*.

—Redrawn by Randall Tweet from original plans in the National Archives.

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